

NASA-CR-191964

# **CLARK ATLANTA UNIVERSITY**

**High Performance Polymers and Ceramics Center**

## **Progress Report**

**1992**

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**Director: Dr. Eric A. Mintz**  
**Associate Director: Dr. Lebone Moeti**



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## EXECUTIVE SUMMARY

The NASA funding allowed Clark Atlanta University (CAU) to establish a High Performance Polymers And Ceramics (HiPPAC) Research Center. The HiPPAC Center is consolidating and expanding the existing polymer and ceramic research capabilities at CAU through the development of interdepartmental and interinstitutional research in: (1) polymer synthesis; (2) polymer characterization and properties; (3) polymer processing; (4) polymer-based ceramic synthesis; and (5) ceramic characterization and properties. This Center has developed strong interactions between scientists and materials scientists of CAU and their counterparts from sister institutions in the Atlanta University Center (AUC) and the Georgia Institute of Technology. As a component of the Center, we have started to develop strong collaborations with scientists from other universities and the HBCUs, national and federal agency laboratories, and the private sector during this first year.

As originally envisioned, the focus of the CAU-NASA-HiPPAC Center in the first nine months has been on infrastructure development. This infrastructure development has included the acquisition of instrumentation, setting up an office to support the HiPPAC Center, initiating the NASA-HiPPAC fellowship program, facilitating the formation of focused research clusters, and developing a mechanism for monitoring and evaluating the progress of research projects to be conducted in the HiPPAC Center. HiPPAC investigators have developed and submitted proposals for infrastructure development, instrumentation, student support and research programs to Federal agencies and industry. Complementary resources from a broad base of Federal Agencies and Industry will complement the NASA funding of the HiPPAC Center activities, and will help to ensure the long term success of the HiPPAC Center.

During this first year of the HiPPAC Center, we have brought together a highly qualified team of investigators to address important problems in the synthesis, characterization and processing of high performance polymers and ceramics. Because of the strong capabilities of the Center team in polymers and ceramics research and the attendant human resources training, especially of minority students, the HiPPAC Center should make important contributions to its fields of focus and interests.

During this first year we have refined the focus of the research in the HiPPAC Center to three areas with seven working groups, that will start programmatic activities on January 1, 1993, as follows:

### Electronic and non-linear optical materials

Nonlinear Optical Properties of Chitosan Derivatives

Polymeric Electronic Materials

Nondestructive Characterization and Prediction of Polyimide Performance

### Polymer-based composites

Solution Processing of High-Performance Materials



## Processable Polyimides for Composite Applications

### Polymer-based ceramic composites

#### Sol-Gel Based Ceramic Materials Processing

#### Synthetic Based Processing of Pre-ceramic Polymers

A major objective of the HiPPAC Center this year has been the development of a vigorous recruitment program. One component of this was being a co-sponsor of "A Forum on Undergraduate Research Experiences of Minority Science, Mathematics and Engineering Students and A Workshop on Graduate School Opportunities" held October 15-17, 1992, at the Georgia World Congress Center, Atlanta, GA.



## A. DOCUMENTATION OF RESEARCH PROJECTS

1. Project title  
Not applicable
2. Publications submitted and/or prepared  
Not applicable
3. Presentations at professional conferences  
Not applicable
4. Patents and copyrights resulting from research projects  
Not applicable

## B. DOCUMENTATION OF RESEARCH PROJECTS

1. Publicity of Center  
See Appendix 1.
2. Organization and staffing

Director	Dr. Eric A. Mintz
Associate Director	Dr. Lebone T. Moeti
Program Manager	Dr. Reginald Lindsey
Administrative Assistant	Ms. Fay Nugent

The administrative and technical head of the Center is Dr. Eric A. Mintz, the Center Director. Each research group has a designated Group Leader who is responsible for the coordination of the activities of the group. Besides ensuring the smooth functioning of the group for meeting program productivity requirements, the group leader will coordinate multidisciplinary research projects. The Associate Director, Dr. Lebone T. Moeti, is responsible for research programs, and coordinates the activities of the Group Leaders. The director, associate director, and group leaders are assisted by a project manager and an administrative assistant.

The Center director, Dr. Eric A. Mintz, joined the faculty of Atlanta University in September 1988 as an associate professor of organometallic chemistry, after serving seven years on the faculty of West Virginia University. In September 1989, Dr. Mintz was appointed as coordinator of graduate studies for the Chemistry Department, with responsibilities for graduate student recruitment and advising, development of industrial relations and day-to-day oversight of the department's graduate program. In September 1990, Dr. Mintz was given additional duties as vice chair of the Chemistry Department.

In September 1990, Dr. Mintz was also appointed as the Director of the Materials Science Laboratory under the new CAU Research Center for Science and Technology, with responsibilities to provide leadership in the development and implementation of the materials research programs of the Research Center. These duties include development and implementation of education, technology transfer and outreach programs in materials science, assisting with marketing and finding resources to support the programs of the materials research program, and providing leadership in conceiving, developing and implementing linkages with HBCUs/MIs,





major research universities, business and industry, and developing a technology incubator program for small businesses in materials science. The duties of Director of the HiPPAC center overlap with these duties and assignments.

During the last four years Dr. Mintz, in conjunction with the Office of the Vice President for Research and Sponsored Programs, has vigorously interacted with industry in increasing support for the Department of Chemistry. He has also been active in developing interactions with other HBCUs, majority institutions, and federal laboratories.

As, Center Director Dr Mintz is responsible for the following:

- The overall functioning of the Center, including the preparation and submission of research proposals, annual reports, etc;
- Initiation and monitoring of grant activities both programmatically and fiscally;
- Working with the Associate Director and the Group Leaders in coordinating and monitoring of research and educational activities of the Center;
- Fostering relationships between the Center and funding agencies, national and federal agency laboratories, historically black colleges and universities, other higher educational institutions, and business and industry;
- Long-range planning for the growth and vitality of the Center; and,
- Keeping abreast of technical developments in the Center's areas of specialization.

Dr. Lebone T. Moeti was appointed in March 1992 as the associate director for the HiPPAC Center. Dr. Lebone T. Moeti joined Clark Atlanta University in September 1991 as a Senior Research Scientist and Associate Professor of Industrial Chemistry and Chemical Engineering. Dr. Moeti's research activities include high temperature ceramic materials and polymer-based composites. Dr. Moeti also serves as an advisor to dual degree engineering students at CAU. His other duties at CAU include serving as the director of the CAU Laboratory for Advanced Aerospace Structures (LAAS). He is also a member of the Georgia Environmental Technology Consortium (GETC) Planning Board.

The director, the associate director, and the group leaders are assisted by a program manager, Dr. Reginald Lindsey, and an administrative assistant, Ms. Fay Nugent, who performs clerical functions, maintains records, prepares budget and expenditure reports, and provides liaison with the Offices of Sponsored Programs and Grants and Contracts, and other administrative units of the University; processes requisitions, assists with technical typing and preparations of manuscripts for Center members, and carries out general administrative tasks involving recruitment, coordination with the academic departments, government agencies and business and industry relations, interactions with the HBCUs, and other activities.

### **Internal Center Advisory Committee**

The Internal Center Advisory Committee assists the Director in the formulation, planning, and evaluation of policies and guidelines for the research and education programs of the Center. In particular, this Committee ensures smooth coordination between the academic departments and Schools of the University, and the Center. The Internal Center Advisory Committee is constituted as follows: Three representatives of the chairpersons of the CAU Science and Mathematics Departments, the Dean of Arts and Sciences, the Director of the CAU-PRISM-D program, the



Director and Associate Director of the Center, a faculty representative from the AUC, the Director of the Georgia Tech's Polymer Education and Research Center, the Vice President for Research, ex officio and the Vice President for Budget and Finance, ex officio.

### **External Advisory Committee**

An important component of the Center is the External Advisory Committee. Members have been identified on the basis of the following qualifications: national stature; sensitivity, interest, and commitment to HBCUs; understanding of the needs and culture of academic or corporate R&D centers or national and federal agency laboratories; experience in conceptualizing research programs or developing institutions or organizations; interest in and capacity to assist the growth and development of the Center; interest in promoting research collaboration between his or her organization and the Center; and willingness to participate in annual reviews of the Center's operations, plans, and direction.

We have been successful in attracting the following persons of national prestige and stature who meet these criteria to serve on the External Advisory Committee: T. Barton, (Director, the Ames Lab of the U.S. Department of Energy and Iowa State University, Department of Chemistry); G. Collins (Hoechst Celanese, Research Division); A. Eisenberg (McGill Univ.); V. Franchetti, Director (Technology, Monsanto Chemical Co.), D. Hylton (Exxon, Senior Staff Scientist); T. Jackson (Lockheed Aeronautical Systems Co.); R. Lenz (Univ. of Mass., Dept. of Polymer Science and Eng.); J. McGrath (Virginia Polytechnic Inst., Dept. of Chemistry and Director, the NSF Science and Technology Center High Performance Polymeric and Composites Center); G. Poehlein (Georgia Tech, VP for Interdisciplinary Programs); K. Raju (Amoco Performance Products, Inc.); D. Seyferth (MIT, Dept. of Chemistry); and D. Sogah (Cornell Univ., Dept. of Chemistry). Drs. Barton and McGrath serve as co-chairs of the External Advisory Board. Additional members will be added to this committee in 1993.

The following internal reporting requirements have been established for the HiPPAC Center starting January 1, 1993 when programmatic work on research projects starts.

Each research group will provide quarterly progress reports on April 1, July 1, and December 1, which will be forwarded to the Internal and External Advisory Committees for review. These progress reports will be used to carry out mid-course assessments of progress. Funding priorities may change based upon these assessments. A comprehensive progress report will be due September 1 of each year. The External Advisory Committee will review these reports and will meet in October to hear presentations from all of the HiPPAC investigators. Based upon these progress reports and the oral presentations, the External Advisory Committee will make recommendations to the HiPPAC Center director on the funding levels for individual investigators and research groups for the subsequent year. New group proposals may also be submitted in September along with progress reports for consideration for the subsequent year. The quarterly and comprehensive progress reports will form the basis for the NASA annual progress report.

Each progress report will include:

- Project title
- Publications submitted and/or prepared



- Presentations at professional conferences
  - Patents and copyrights resulting from research projects
  - contribution of each investigator
  - resources expended
  - role of students
3. Description of student tracking method (include sample report, screen layout, forms, etc. where applicable)  
See Sections D and E.
  4. Description of strategies to recruit underrepresented minority faculty and students  
Also see Sections D and E.

The Chemistry Department has implemented an aggressive graduate student recruitment program, which the HiPPAC Center complements, that includes faculty visits to other campuses and inviting prospective graduate students to CAU to meet faculty and current students. This program is already paying off. The current chemistry graduate student body is approximately 70% African American at a time when many chemistry departments are experiencing considerable difficulty in attracting American students. The Chemistry Department and the HiPPAC Center have also been active participants in undergraduate student recruitment activities including the science recruitment weekend. The number and quality of entering freshmen declaring chemistry as their intended major has increased. This past year's entering class of chemistry majors included 9 freshman receiving full fellowships from the ONR or NASA-HiPPAC programs, based upon their achievements in high school and the SAT exam. The undergraduate chemistry student body is over 90% African American.

The next year science recruitment weekend will be held February 26-28, 1993. Viable applicants from the pool of applicants will be invited to the recruitment weekend at the University to meet the faculty, tour the campus and interviews with departments. Following the interviews and final evaluations of applications, selected students will be sent letters of award. Each year of the three years that we have held this program we have attracted at least four times as many qualified and deserving students seeking support as are available positions.

5. Equipment Purchased:  
See #8 below.
6. Interactions with NASA Field Installations.

Drs. Eric Mintz and Lebone Moeti visited NASA Lewis Research Center on March 2, 1992, to determine areas of overlapping research interest and possible research collaborations. The main contacts on this visit were Dr. Michael Meador, Chief, Polymers Branch, Dr. Frances Hurwitz, and Dr. Julian M. Earls, Director, Office of Health Service, NASA Lewis.



Drs. Mintz, Moeti, Moghazy, Harruna, Mitchell and, Tolbert visited NASA MSFC on August 7, 1992 to determine areas of overlapping research interest and possible research collaborations.

Dr. Frances Hurwitz (NASA Lewis), Dr. Seth Marder (JPL), Mr. Stephen Moran (NASA Headquarters), Dr. Benjamin Penn (NASA-Marshall Space Flight Center), Dr. Terry St. Clair (NASA Langley), and Ms. Sheree Stovall-Alexander (NASA-Headquarters) attended a site visit for the HiPPAC Center on October 19, 1992. See Appendix 2

Dr. Michael Meador, Chief, Polymers Branch, NASA Lewis Research Center, presented a seminar "High Temperature Polymers and Polymer Matrix Composites" at CAU on October 20, 1992 and spent the day interacting with HiPPAC investigators.

Dr. Nagi Wakim of NASA-Goddard Space Flight Center conducted a two day workshop on the Minority University Space Interdisciplinary Network (MU-SPIN) at CAU on November 12-13, 1992. This workshop was well received. Software to access MU-SPIN has been installed, and is being utilized by the HiPPAC Center.

Based upon reviewing the HiPPAC proposal, scientists at NASA-JPL asked us to develop a program to test optical fibers. This interaction led to a contract on "Experimental Measurement of the Physical and Mechanical Properties of Polarization-Maintaining Optical Fiber." Mr. Edward Cuddihy, Group Supervisor - Failure Analysis Group, Electronic Parts Reliability Section, NASA-Jet Propulsion Laboratory who is the technical monitor of the JPL project with the HiPPAC Center visited CAU and Georgia Tech on: June 29 and 30, 1992, August 24 and 25, 1992, and October 19 - 23, 1992. Based upon the high quality of the work done on this project we have been asked to submit a proposal to do more contract work in this area for JPL. See Appendix 3 for progress reports for this project.

Dr. Cardelino spent much of summer 1992 at the NASA Marshall Space Flight Center.

#### 7. Affiliations with industry, other HBCUs

The HiPPAC Center has developed strong interactions with industry during its first year. These interactions include the inclusion of industrial scientists on the External Advisory Committee, development of collaborative research programs with industry scientists. Several members of the External Advisory Committee have committed to developing stronger ties with the HiPPAC Center including offering summer internships to students and faculty as well as providing funds for additional support of students in the HiPPAC Center.

BP America was the first company to support the HiPPAC Center. It was sufficiently impressed with the NASA-HiPPAC proposal, that it has provided \$20,000 (9/91-8/93) in support for students in the chemistry department interested in working on High Performance Polymers and Ceramics. Hoechst Celanese has recently provided \$9,000 as a first installment to provide partial scholarship support for two undergraduates and one graduate student for four years who are interested in working on HiPPAC projects. During this year we have started interactions with





Monsanto, and next year Monsanto will start a seminar series at CAU. In addition Monsanto has awarded a scholarship fund for undergraduate students studying chemistry or chemical engineering at CAU.

Drs. Eric Mintz and Lebone Moeti visited Amoco Performance Products, Inc., Research and Development Center in Alpharetta, GA on September 10, 1992, to acquaint Amoco researchers with the capabilities of the HiPPAC Center and to discuss the setting up and exchange of speakers and to develop summer internship possibilities for students.

Mr. Charles P. Logan, Jr., Director of C/C Business Development, BP Chemicals (Hitco), Inc., Advanced Materials Division, and Dr. Frances Hurwitz (NASA Lewis) visited the HiPPAC Center on July 24, 1992, to discuss possible collaborative efforts in Chemical Vapor Deposition (CVD) particularly as applied to carbon-carbon composites.

We have developed two research proposals in conjunction with General Dynamics (see section B-10).

As part of the program of the Advanced Laboratory for Advanced Aerospace Structures (LAAS), which was developed to complement the HiPPAC Center, Lockheed Aeronautical Systems Company of Marietta, Georgia, NASA JPL, and Battelle Pacific Northwest Laboratories have committed to assisting CAU to develop its aerospace R&D and education programs. There have also been exchange of visits between CAU and United Technologies to identify areas of cooperation. These companies and organizations have assigned the following persons to work with CAU:

#### **Lockheed Aeronautical Systems Company**

Tony Jackson, Program Manager for NASA Programs  
Peter R. Smith, Department Manager, Aerodynamics

#### **NASA JPL**

Phil Garrison, Manager, Propulsion and Chemical Systems Section  
Gerald Voeck, Chemical Sensors Program  
Nicholas Moore, Sr., Propulsion and Structural Mechanics Program

#### **Battelle Pacific Northwest Laboratories**

Erik Pearson, Manager, Analytical Sciences Department, Applied Physics Center

On September 16, 1992, Drs. Bota and Mintz visited Prairie View A & M University to further develop collaborative research programs between the two universities. CAU has an extensive network with HBCUs, minority and majority institutions, federal and national laboratories, and industry to support the proposed activities and to leverage additional resources.



**AUC Institutions.** Under the AUC arrangement, we involve students and faculty of Morehouse, Morris Brown, and Spelman Colleges in all aspects of the HiPPAC Center. Under the existing AUC relationship, the facilities and scientific equipment of the CAU HiPPAC Center are available to faculty and students of all AUC institutions.

As part of CAU's commitment to increase research in materials research at HBCUs, we incorporated an HBCU Cooperative Research Initiative Program in Composites (CRIP-C) in the proposed programs of the LAAS Laboratory. We have committed \$116,000 (9/92-8/95) to initiate collaborative research programs with other HBCUs through the CRIP-C program. These funds will support workshops and meeting with other HBCUs to develop this program. Some of the proposed areas of research in composites that may be developed as part of the CRIP-C program are the following:

**Fastener Development.** There is a need for the development of light weight high temperature (3000 °F) fasteners for use on the National Aerospace Plane, Space Station and F-22 programs. The materials satisfying the requirements of the programs have not been developed. R&D and testing of new materials is essential for meeting the goals of these programs.

**Penetrator Development.** There is a need for the development of a penetrator, with equal or greater capability, for Army and Air Force programs to eliminate the hazardous Depleted Uranium (DU) penetrator presently being used. The present substitute, the Tungsten penetrator, has not equaled the performance of the DU penetrator. Research in this area will involve the development of coated powders and processing parameters for consolidation to the penetrator.

**High Temperature Seal Development.** Materials for sealing high temperature engine and structural components for F-22 and NASP programs have not been fully developed or proven. An initial effort designed to identify and demonstrate feasibility for materials to insulate and survive the required wear and temperature conditions will be undertaken.

**Nozzle Development.** The development and integration of engine and airframe components is a goal for future Aircraft related programs to increase performance and reduce weight of future vehicles. Present design limitations are materials related. The high temperature and structural conditions required have made this task difficult. A program to identify and qualify materials for these tasks is required.

**Metal Matrix Composites Development.** The development of metal matrix composites (MMC) materials for structural applications has led to a new class of materials. Two of the leading MMC candidates presently being pursued for various applications are the Titanium matrix and Nickel Aluminide composites. Research efforts to conduct processing studies, continuous fiber development, powder development, coating and quality procedures for the fabrication of these composites are required.



**Thermoplastic Polymers.** The desire for higher temperature light weight polymer composites has resulted in the use of thermoplastic composites for various applications. The experience and understanding of these materials is not at the level needed for large structural manufacturing. Large scale processes, tooling, characterization and specifications development are needed to successfully utilize these materials in programs such as the F-22 and the Space Station.

CAU believes that these collaborations will result in multiple benefits for the HBCUs involved such as:

- The learning process of the infrastructure development at each HBCU will be similar. In fact, the use of CAU essentially as a prototype for R&D infrastructure development at HBCUs will allow other HBCUs to learn from CAU's experience, and accelerate their infrastructure development process.
- The development of complementary technologies will enable the HBCUs to team together on various federal programs and develop business opportunities not previously obtained.
- The interaction on the research level will allow these HBCUs to develop complementary recruitment and retention programs to enhance the general participation of minorities in engineering and scientific fields.
- The communication between industry and these HBCUs will focus research and training efforts on state-of-the-art technologies.

8. Report of Equipment purchased including item name, purpose and location.

Item	Location
<b>Instron Universal Testing Instrument with Accessories</b>	<b>115 McPheeters-Dennis</b>
The model 4505 INSTRON system which will be used to measure mechanical properties such as modulus and tensile strength of both ceramic and polymer materials (fibers, films, composites, etc.). Capabilities exist with the accessories and environmental chamber to determine mechanical properties at different temperatures including strain measurements using an extensometer.	
<b>Dynamic Modulus Tester</b>	<b>115 McPheeters-Dennis</b>
Model PPM-5R will measure the modulus of materials nondestructively using sound waves. The sonic modulus of polymer and ceramic materials in fiber or film form can be determined rapidly and accurately. In addition, sonic modulus of materials can be determined as a function of load.	



**Cathetometer****115 McPheeters-Dennis**

A-II X-Z Measuring Machine is used to measure extension in creep experiments and to support nondestructive capabilities (simultaneous measurement of sonic modulus and elongation).

**Sintering Furnace****311 Merrill Hall**

1700 °C box furnace is used to calcine and sinter materials. Heating to lower transition temperatures for polymers and higher temperatures for ceramics. Programmable heating capability.

**Tube Furnace****311 Merrill Hall**

1700 °C tube furnace is used to calcine and sinter materials with the ability to have atmosphere control by heating to lower transition temperatures for polymers and higher temperatures for ceramics. Programmable heating capability.

**Hydraulic Press****311 Merrill Hall**

Model 20-1310 specimen mount press for processing polymer and ceramic materials. Low pressure compacting for specimen preparation.

**Cold Isostatic Press****311 Merrill Hall**

Model CIP42260 is used to compact and densify materials at room temperature. Green compacts of ceramic materials can be prepared prior to sintering to prepare final ceramics with improved density.

**Mercury Porosimeter****311 Merrill Hall**

The model 9320 is used to measure pore volume and pore volume distribution versus pore size, total pore area, and pore area distribution for both ceramic and polymeric materials.

**GPC****309 Merrill Hall**

The model LC-95 with accessories is used to determine molecular weights and molecular weight distributions for polymers.

**HPIIc Scanner with PC Interface****HiPPAC Office**

HPIIc Scanner with PC Interface is used in document preparation.

**FAX Machine****HiPPAC Office**





The HP FAX-310 is used for rapid document communication.

**High Speed Copy Machine**

**HiPPAC Office**

The Ricoh FT-8880 is used for reproducing documents.

**Macintosh**

**HiPPAC Office**

The Macintosh IICi with Monitor is used for document and presentation preparation.

**PC**

**HiPPAC Office**

The Magitronic 486/33 and monitor are used for document preparation and maintaining student tracking data, and budget and expenditure data for the HiPPAC Center.

**Printer**

**HiPPAC Office**

The NEC Model 95 printer is interfaced with the PC and the Macintosh.

**Balances**

**Various locations**

Top loaders and analytical balances are for weighing materials for synthesis and processing.

9. Presentations at professional conferences

Not Applicable

10. Proposals submitted by principal investigators for funding through external sources and funding received in support of the center activities. Highlight funding from other NASA sources.

We have only included proposals that have P.I.(s) or Co-P.I.(s) from an AUC institution (e.g. proposals from purely Ga. Tech. HiPPAC-Co-PIs have not been included).

**Institutional Proposals:** Other centers that will complement the HiPPAC Center include the Laboratory for Advanced Aerospace Structures (LAAS). The LAAS center which is a component center in the recently funded proposal "Enhancing Clark Atlanta University Participation in Defense Research" will conduct research in solid mechanics, fluid mechanics, propulsion, and composite materials. The interactions that will develop between the HiPPAC center and the LAAS laboratory will focus on composite materials, specifically, polymer-based and ceramic-based composites. See Appendix 4 for the abstract of this proposal.



**Funded**

Project Title: Enhancing Clark Atlanta University Participation in Defense Research (DAAL03-92-G-0380)  
PIs: K. B. Bota and E. A. Mintz  
Source: ARO  
Amount: \$12,800,000  
Period: 9/92-9/31/95  
Subproject: Laboratory For Advanced Aerospace Structures (LAAS) In Support of The Air Force Wright Laboratory  
Director: L. Moeti  
Amount: \$1,622,670  
Period: 9/92-9/31/95

**Equipment Proposals:** As part of the infrastructure development of the HiPPAC Center, HiPPAC Center investigators have submitted proposals to acquire major instrumentation to support the HiPPAC Center. See Appendix 4 for the abstracts of these proposals.

**Funded:**

Project Title: Thermal Analysis System for Characterization and Evaluation of High Performance Polymers (HRD-9253016)  
Director: E. Mintz  
Source: NSF/RIMI  
Amount: \$160,000  
Period: 9/15/92-8/31/94

**Pending:**

Project Title: Acquisition of an FT-Raman Instrument for Application in Surface Science and Catalysis  
P.I.(s): M. Mitchell  
Co-P.I.(s): Y. Mariam, E. Mintz  
Source: DOE  
Amount: \$110,500  
  
Project Title: High-Field Nuclear Magnetic Resonance Spectrometer for Characterization and Evaluation of High Performance Polymers and Ceramic Precursors  
P.I.(s): I. Khan  
Co-P.I.(s): L. Torres, E. Mintz, L. Moeti, Y. Mariam  
Source: DOE  
Amount: \$279,557

**Student Support Proposals:** HiPPAC Center investigators have submitted proposals to provide additional student support to complement NASA funding of students, including one currently pending at NASA JPL (Jet Propulsion Laboratory Program for Research Integration and Support



for Matriculation to the Doctorate at Clark Atlanta University). See Appendix 4 for abstracts of these proposals.

Funded

Project Title: Clark Atlanta University Research Experiences for Undergraduates in Chemistry Program  
P.I. (s): C. Parker  
Co-P.I.(s): M. Mitchell, E. Mintz, H. McBay, L. Moeti  
Source: National Science Foundation  
Amount: \$40,000  
Period: 6/92-5/93

Pending

Project Title: Synthesis and Processing of High Performance Polymers and Polymer-Based Carbon and Ceramic Materials  
PI(s): A. Abhiraman, (Ga. Tech.)  
Co-P.I. (s) P. Desai (Ga. Tech.), M. Polk (Ga. Tech.), L. Tolbert (Ga. Tech.), S. Warner (Ga. Tech.), I. Khan, L. Moeti, E. Mintz, Y. Mariam, M. Mitchell  
Source: NSF  
Amount: \$1,332,000  
Period: 5 years

Project Title: Enhancing Research Collaboration Between CAU and CERWAT at Georgia Tech for Training Minority Students  
P.I (s): L. Moeti  
Co-P.I.(s): E. Mintz, E. Armanios (Ga. Tech.)  
Source: Army Research Office  
Amount: \$448,739  
Period: Three years

Project Title: Clark Atlanta University Research Experiences for Undergraduates in Chemistry Program  
P.I.(s): C. Parker  
Co-P.I.(s) L. Torres, M. Mitchell, E. Mintz, L. Moeti, H. McBay  
Source: National Science Foundation  
Amount: \$146,754  
Period: 6/93-5/96

Title: Jet Propulsion Laboratory Program for Research Integration and Support for Matriculation to the Doctorate at Clark Atlanta University.  
Agency: NASA-Jet Propulsion Laboratory  
Amount: \$352,289  
Period: Four years



P.I.(s): M. Webb  
Co-P.I.(s): E. Mintz, L. Moeti

**Research Proposals:** Several research grants have been submitted by HiPPAC investigators to support research that will complement HiPPAC center activities. One of these proposals is funded by NASA-JPL (Experimental Measurement of the Physical and Mechanical Properties of a Polarization-Maintaining Optical Fiber) and another has been approved for funding starting January 1, 1993 by NASA Lewis (Superconducting Materials Processing). See Appendix 4 for abstracts of these proposals.

**Funded**

Title: A Planning Grant for Research on High Temperature Oxide and Non-Oxide Ceramic Fibers. Grant # (DMR-9252993)  
Agency: National Science Foundation  
Amount: \$12,000  
Period: 4/1/93 to 9/30/93  
P.I.(s): L. Moeti

Title: Superconducting Materials Processing Grant # (NAG3-1394)  
Agency: NASA-Lewis  
Amount: \$324,611  
Period: 1/93 to 12/95  
P.I.(s): T. Mensah

Title: Experimental Measurement of the Physical and Mechanical Properties of a Polarization-Maintaining Optical Fiber.  
Agency: Jet Propulsion Laboratory (Contract # 959381)  
Amount: \$39,082  
Period: 6/30/92 to 1/30/93  
P.I.(s): L. Moeti  
Co-P.I.(s): S. Moghazy, P. Desai (Ga. Tech.), A. Abhiraman (Ga. Tech.)

**Pending**

Project Title: Protective Bore Coatings for Large Caliber Guns  
P.I.(s): L. Moeti  
Co-P.I.(s): E. Mintz, M. Mitchell, O. Sowemimo, J. Lackey (GTRI), T. Starr (GTRI), G. Freeman (GTRI), E. K. Barefield (Ga. Tech.)  
Source: U.S. Army, ARDEC  
Amount: \$1,566,862  
Period: Three years

Title: Battelle Request for Qualification





Agency: Battelle-Pacific Northwest Laboratories  
 Amount: Task Order Deliveries  
 Period: Five Years  
 Co-P.I(s): G. Abotsi, J. Bender U. Eanemesang, D. Graves, I. Khan, Y. Mariam, E. Mintz, M. Mitchell, L. Moeti, Muldrow, P. Musey, C. Parker, P. Phillips, L. Torres,

Title: Tribological Testing of Ceramic Bore Coatings for Guns.  
 Agency: U.S. Army, ARDEC  
 Amount: \$643,717  
 Period: Three Years  
 P.I(s): L. Moeti  
 Co-P.I(s): M. Mitchell, O. Sowemimo, G. Freeman (GTRI), J. Lackey (GTRI)

Title: Organic and Inorganic Aerogels for Aerospace Applications.  
 Agency: Wright Laboratory  
 Amount: \$666,278  
 Period: Four Years  
 P.I(s): L. Moeti  
 Co-P.I(s): E. Mintz, M. Mitchell  
 Subcontractor: General Dynamics, M. Jones (GDFW), U. Wettermark (GDFW), T. Woodrow (GDFW)

Title: Injection Molding of Electrically Active Thick Optically Transparent Panels.  
 Agency: Wright Laboratory  
 Amount: \$448,127  
 Period: Three Years  
 P.I(s): L. Moeti  
 Co-P.I(s): M. Mitchell  
 Subcontractor: General Dynamics, M. Jones (GDFW), T. Woodrow (GDFW)

Title: Regenerable Polymeric Reagents for the Preparation of Optically Active Alcohols and Conductive Polymeric Matrix as the Active Component in Sensors for Chiral Molecules  
 Agency: MBRS-NIH  
 Amount: \$130,000  
 Period: 2/93-1/95  
 P.I(s): I. Khan

#### 11. Forums, symposia sponsored or attended

The CAU-NASA-HiPPAC Center was a co-sponsor of "A Forum on Undergraduate Research Experiences of Minority Science, Mathematics and Engineering Students and A



Workshop on Graduate School Opportunities" October 15-17, 1992, Georgia World Congress Center, Atlanta, GA. Appendix 5 and 6 "Abstract of Student Poster Presentations" "List of Participants " Appendix 7.

Faculty and undergraduate juniors and seniors from Historically Black Colleges and Universities (HBCUs), Hispanic Colleges and Universities, and other minority institutions (MIs) including Native American-serving institutions were invited to attend a Forum on Undergraduate Research Experiences of Minority Undergraduate Science and Engineering Students and a Workshop on Graduate School Opportunities held on October 15-17, 1992 in Atlanta, Georgia. The forum and workshop were organized and sponsored by the HBCU/MI Environmental Technology and Waste Management Consortium. Other sponsors included the CAU-NASA-HiPPAC Center, the Massachusetts Institute of Technology, the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the Army.

The minority institutions invited were those that have been major producers of minority science, mathematics, or engineering graduates. These MIs have also received significant federal R&D funds and have quality faculty in the sciences, mathematics, and engineering. Thus, the Forum and Workshop were an excellent and unique opportunity for faculty and students to interact with other HBCUs/MIs and Major Research Institutions (MRIs).

Over five hundred (500) minority juniors and seniors and more than seventy-five (75) HBCU/MI faculty members and chairpersons in the natural sciences, engineering, computer and information sciences and mathematics attended the forum and workshop. Students presented posters on research projects conducted in the summer or academic year. Representatives from the MRIs and the HBCUs/MIs discussed issues related to, and opportunities for, graduate studies.

One of the primary objectives of the forum and workshop was to make HBCU/MI faculty and students aware of the many fellowships, research and teaching assistantships, etc., available for graduate study in mathematics, the sciences and engineering. Hence, representatives from fellowship awarding agencies such as NSF, DOE, ONR, GEM, the American Society for Engineering Education (ASEE), the National Research Council, etc., were also invited.

This event was unique. It should assist in forging a long-term relationship between and among the HBCUs/MIs that produce quality science, engineering, and mathematics B.S. graduates, and major research institutions, national and federal research laboratories, and other agencies. From the lessons learned in the first year of this program, we intend to make this an annual event. Each year, MRIs and agencies that have demonstrated commitment to minority graduate education and faculty and students from HBCUs and other MIs will be invited to attend the forum and workshop. With the increasing emphasis on alliances among higher education institutions, government and industry, this should contribute to the dialogue on mechanisms to nurture and convince more black and Hispanic students to pursue graduate studies and R&D careers.

The HiPPAC Center seminar series was initiated this year with speakers from CAU, other AUC schools, and Ga. Tech. See Appendix 8 for seminar announcements.



12. Strategies for technology transfer

See previous sections.

13. Advisory Committees

a) Names, Titles, and affiliation of internal and external advisory committee members.

Name	Title	Affiliation
T. Barton,	Director Professor of Chemistry	Ames Lab-ISU Iowa State University
G. Collins	Research Associate	Hoechst Celanese, Research Division
A. Eisenberg	Professor of Chemistry	McGill Univ.
V. Franchetti	Director, Technology	Monsanto Chemical Co.
D. Hylton	Senior Staff Scientist	Exxon Chemical Co.
T. Jackson	Program Manager for NASA Programs	Lockheed Aeronautical Systems Co.
R. Lenz	Professor of Polymer Science and Eng.	Univ. of Massachusetts
J. McGrath	Director  Professor of Chemistry	NSF Science and Technology Center: High Performance Polymeric Adhesives and Composites Virginia Polytechnic Inst.
G. Poehlein	VP for Interdisciplinary Programs	Georgia Tech
K. Raju	Research Scientist	Amoco Performance Products, Inc.
D. Seyferth	Professor of Chemistry,	MIT
D. Sogah	Professor of Chemistry	Cornell Univ., Dept. of Chemistry

Drs. Barton and McGrath serve as co-chairs of the external advisory board.

b) Agenda and minutes of advisory committee meetings.

See Appendix 9.

c.) Utilization of postdoctoral research assistants.

Note Applicable



## C. DOCUMENTATION OF FACULTY PARTICIPATION

### 1. Names, academic title department, ethnic background of PI and other faculty participants

Name	Academic Title	Discipline	Institutional Affiliation	Center Role
E. Mintz	Assoc Prof	Chemistry	CAU	Director
L. Moeti	Sr. Res. Sci	Chem. Engineering	CAU	Associate Director
A. Abhiraman	Professor	Chem. Engineering	Georgia Tech	Co-PI
D. Collard	Asst. Prof.	Chemistry	Georgia Tech	Co-PI
B. Cardelino	Res Sci	Chemistry	Spelman	PI
S. Bhatia	Asst. Prof.	Chemistry	Spelman	PI
P. Desai	Asst. Prof	Textile & Fiber Eng.	Georgia Tech	Co-PI
I. Harruna	Assoc. Prof	Chemistry	Morris Brown	PI
I. Khan	Asst. Prof	Chemistry	CAU	PI
Y. Mariam	Professor	Chemistry	CAU	PI
T. Mensah	Sr. Res. Sci	Chem. Engineering	CAU	PI
M. Mitchell	Asst. Prof.	Chemistry	CAU	PI
S. Moghazy	Asst. Prof	Physics	CAU	PI
J. Muzzy	Professor	Chem. Engineering	Georgia Tech	Co-PI
C. Parker	Assoc. Prof.	Chemistry	CAU	PI
C. Papageorgopoulos		Physics	CAU	Co-PI
M. Polk	Professor	Textile & Fiber Eng.	Georgia Tech	Co-PI
J. Reed	Assoc. Prof	Chemistry	CAU	PI
A. Rodriguez	Assoc. Prof	Chemistry	CAU	PI
R. Samuels	Professor	Chem. Engineering	Georgia Tech	Co-PI
O. Sowemimo	Asst. Prof.	Physics	CAU	PI
L. Tolbert	Professor	Chemistry	Georgia Tech	Co-PI

	Under represented		non-minority	US Citizens	Permanent Resident	Total Faculty Researchers
	male	female	female			
CAU	7			8	4	12
Other AUC	1	1		1	2	3
Ga. Tech.	1			4	1	6

### 2. Brief Statement of the nature of teaching and nonteaching faculty participation, e.g. principal investigator, student research advisor, core research leader, etc.

Not Applicable

### 3. Representation among the disciplines targeted by the Center

See C-1.





## D. DOCUMENTATION OF STUDENT PARTICIPATION

### 1. Procedures for Selecting Student Participants

The primary criteria for selection of NASA-HiPPAC participants is that they be American minority of exceptional high ability. Prospective participants had to be an incoming college freshman or graduate student with the intent to major in chemistry, physics or engineering. Students selected to participate in the NASA-HiPPAC Program were required to complete an application including an essay describing their career goal as it relate to being a HiPPAC Fellow. Students also were required to submit a resume, three letters of reference or other forms of recommendation, and a high school transcript. Students were evaluated based upon their standardized test scores, grades earned in high school math and science courses, and grade point average. Students selected to be NASA-HiPPAC Fellows are expected to agree to Conditions attending to the NASA-HiPPAC research assistantship, and sign a NASA-HiPPAC Research contract. See Appendix 10 for HiPPAC application form and the contract HiPPAC student sign.

### 2. NASA-HiPPAC Fellows Participants - Clark Atlanta University

<b>Freshmen Name and Address of HiPPAC Fellows</b>	<b>Current Major</b>	<b>H. S. GPA</b>	<b>Class</b>	<b>Expected Date of Graduation</b>	<b>Ethnic Origin</b>
Anthony Davis	Chem	3.47	Fr	5/96	African Amer.
Shari Earnest	Chem	3.50	Fr	5/96	African Amer.
Jernita Randolph	Chem	3.70	Fr	5/96	African Amer.
Njeri Lawrence	Chem	3.84	Fr	5/96	African Amer.
Sopher Keisha	Chem	3.46	Fr	5/96	African Amer.
<b>Upper Classmen Name and Address of HiPPAC Fellows</b>	<b>Current Major</b>	<b>U. G. GPA</b>	<b>Class</b>	<b>Expected Date of Graduation</b>	<b>Ethnic Origin</b>
Semesha Barnes	Chem	3.93	Soph	5/95	African Amer.
Arun Kori	Chem	3.23	Soph	5/95	Asian Amer.
Suzette Nubie	Chem Eng.	4.00	Soph	5/95	African Amer.

**NASA-HiPPAC Fellows - Georgia Tech.** The NASA HiPPAC Center has a subcontract with Georgia Tech which provides support for three students working with HiPPAC Center PIs and



Co-PIs. In addition Georgia Tech has provide support for an additional three students to work with HiPPAC Center PIs and Co-PIs.

<b>Name and Address of HiPPAC Fellows</b>	<b>Current Major</b>	<b>U. G. GPA</b>	<b>Class</b>	<b>Expected Date of Graduation</b>	<b>Ethnic Origin</b>
<b>Stephen Hardaker</b>	T.Eng.	3.3	Soph	12/92	White Amer.
<b>Thomas Ngo</b>	Chem	2.9	Soph	9/93	Asian Amer.
<b>Curtis Sayer</b>	Chem	3.6	Grad.	9/96	White Amer.
<b>Varunesh Sharma</b>	Poly	3.4	Grad.	6/93	Asian Amer.
<b>Tina Williams</b>	Chem	3.29	Grad.	12/92	African Amer.

### 3. Nature of Student Participation

The NASA-HiPPAC Fellows who are sophomores or above are currently engaged in research activities. Ms. Barnes and Mr. Kori, Sophomore HiPPAC Fellows, participated in the jointly sponsored HBCU Forum on Undergraduate Research Experiences of Minority Undergraduate Science and Engineering Students.

**Arun Kori** prepared a poster presentation on "Functionalization of Polydimethyl Siloxanes via Isonitrile Insertion and 1,2-Silyl Shift on Zirconium."

**Semesha Barnes** prepared a poster presentation on "Mechanical Determination of the Properties of a Polarization-Maintaining Optical Fiber."

### 4. Student Activities and Research Advisors

The current group of NASA-HiPPAC Freshman Fellows will begin interviewing principal investigators in the spring of 1993. They will select research advisors in the Summer or Fall of 1993, at which time they will become actively engaged in a defined research project.

The following HiPPAC Fellows have selected research advisors as indicated.

<b>Student</b>	<b>Research Advisor(s)</b>
Arun Kori	Dr. Lebone Moeti
Semesha Barnes	Drs. Samir Moghazy and Lebone Moeti
Tina Williams	Dr. Issifu Harruna



Stephen Hardaker

Dr. Robert Samuels

Thomas Ngo

Dr. Laren Tolbert

Curtis Sayer

Dr. David Collard

Vinoo Sharma

Drs. A. S. Abhiraman and Prashant Desai

Suzette Nubie

Dr. Lebone Moeti

## E DOCUMENTATION OF CENTER PROGRAM IMPACT

### 1. Recruitment, Retention and Tracking Strategies for underrepresented minority students in the targeted disciplines.

In addition to the HiPPAC Center participating in the CAU Science Recruitment Weekend, described above, student recruitment will include circulating an informative brochure describing the NASA-HiPPAC Fellows program. This brochure will be made available to students, teachers, counselors, and principals via mass mailing. The brochure will provide students with a perforated mail in request for application form. The staff of the NASA-HiPPAC center will work closely with the Atlanta University Center registrars' office to obtain a list of students with high academic credentials who indicate a major in one of the targeted disciplines.

The staff of the NASA-HiPPAC center monitor student's progress by making periodic inquiries to each of the HiPPAC students' teacher and research advisor. Freshman HiPPAC Fellows are required to enroll in the honor's section of general chemistry if they are chemistry or chemical engineering majors. Tutoring is available for all HiPPAC fellows who indicate a need for assistance. Suggestions and changes are made to optimize the student's performance and progress in his/her class work and research performance.

The staff of the NASA-HiPPAC center are working closely with the Office of Institutional Research to put together a tracking system designed especially for HiPPAC Fellows. This data file will include a complete academic profile of the student. Students are to provide the HiPPAC center with information regarding the continued pursuit of their career goals and keep in touch with the HiPPAC center staff as they realize professional and educational advancement.

The data base to be used for tracking each HiPPAC Fellows include the following information:

Student Name

Social Security Number

Permanent Address

Ethnic Origin

Sex

Local Address

Date of Birth

Major

High School Average

ACT & SAT score



## UNDERGRADUATE STUDIES

Name of School	Major	Classification
Semester GPA	Cumulative GPA	Research Advisor
Hours Attempted	Hours Passed	Graduation Date
Withdrawal Date	Reason for withdrawal	New Major

## GRADUATE STUDIES

Name of School	Major	Classification
Semester GPA	Cumulative GPA	Research Advisor
Hours Attempted	Hours Passed	Graduation Date

## POST GRADUATE ACTIVITIES

Name of School/Industry	Position
-------------------------	----------

2. Current enrollment of underrepresented minority undergraduate and graduate students in targeted disciplines

### Statistical Report of Graduate and Undergraduate Students in the Natural and Computer Sciences and Mathematics

FALL 1992

	BLACK			HISPANIC			RACE NOT INDICATED	
SCHOOL/DEPT	M	F	T	F	T	M		TOTAL
GRADUATE								
Biology	7	9	16	0	0		4	25
Chemistry	13	9	22	0	0		9	40
Computer Science	20	18	38	0	0		9	70
Mathematics	6	5	11	0	0		2	16
Physics	5	2	7	0	0		1	14
UNDERGRADUATE								
Biology	46	166	212	0	0		8	224
Chemistry	12	40	52	1	0		7	61
Computer Science	39	74	113	0	1		12	129
Dual Degree (engineering)	82	60	142	0	1		10	156





Mathematics	17	41	58	0	0		8	66
Physics	13	9	22	0	0		1	23

3. Enrollment projections in targeted disciplines for the next five years

Since the consolidation of Clark College and Atlanta University in 1989, we have experienced a dramatic increase in the number of students majoring in the sciences. In the case of chemistry the number of undergraduate majors have increased three-fold. We anticipate a 10 to 20% increase per year in the number of students in Biology, Chemistry, Computer Science, Dual Degree (engineering), mathematics, and Physics over the next five years.

4. Number of full-time teaching and research faculty added to the targeted disciplines

Dr. John Hurley, an African American materials engineer, has accepted an offer to join Clark Atlanta University in Spring 1993. Dr. Hurley's work in electronic materials and their implication in developing new and improving existing microelectronic devices will be an excellent addition to the HiPPAC Center. See Appendix 11 for vita. An additional HiPPAC Scientist will be added by Fall 1993.

In addition, Dr. James Turner, Jr. an African American working in nonlinear analysis of polymeric materials has accepted a position in the mathematics department starting in Spring 1993. Dr. Turner's work is an excellent complement to that of a number of current HiPPAC investigators. See Appendix 11 for vita.

6. Description of new courses and curricula

None

7. Enhancements to existing programs

See previous sections.



## F. FINANCIAL REPORT

1. Dollar amount of expenditures and encumbrances by budget category showing a comparison of planned vs. actual expenditures. Including a report of the University's matching costs

	Planned	Encumbrances and expenditures	Carry Over
	Year 1 1992	Year 1 1992	Year 1 Carry-over
Personnel Salaries			
A. Project Management			
Salary (A)	\$53,385	\$40,755	\$12,630
Fringe Benefits (20.77 %) 26.29	\$11,088	\$10,714	\$374
B. Principal Investigators			
S. Moghazy		\$9,877	(\$9,877)
Salary (B)		\$9,877	(\$9,877)
Fringe Benefits (20.77 %) 26.29		\$2,597	(\$2,597)
C. New Faculty Salaries			
Chem/Mech Eng (Academic Year)	\$20,000		\$20,000
Chem/Mech Eng (Summer)			
Physics/Chem (Academic Year)			
Physics/Chem (Summer)			
Ceramics (Academic Year)			
Ceramics (Summer)			
Ceramics (Academic Year)			
Ceramics (Summer)			
Subtotal (C)	\$20,000	\$0	\$20,000
Fringe Benefits (20.77 %) 26.29	\$4,154	\$0	\$4,154
D. Other Senior Personnel			
Core Facility Technicians	\$21,333	\$21,333	\$0
HBCU Summer Faculty (2)			
Subtotal (D)	\$21,333	\$21,333	\$0
Fringe Benefits (20.77 %) 26.29	\$4,431	\$5,608	(\$1,178)
E. Student Stipends	\$40,534	\$39,134	\$1,400
F. Student Tuition	\$32,550	\$56,394	(\$23,844)
G. Scientific and Office Equipment & Maintenance	\$330,258	\$369,435	(\$39,179)
H. Travel (Domestic)	\$28,000	\$13,432	\$14,568
I. Workshops	\$20,000	\$19,977	\$23
J. Pre-college Programs			
K. Other direct costs			
External Program Evaluation			
Materials and Supplies	\$21,250	\$16,992	\$4,258
Publication costs/Documentation-			
Disseminatory/Brochures	\$3,000	\$3,000	\$0
Subtotal (K)	\$24,250	\$19,992	\$4,258
Total Salaries	\$135,252	\$111,099	\$24,153
Other	\$454,729	\$498,149	(\$43,421)
Total Direct Cost	\$589,981	\$609,248	(\$19,267)
INDIRECT COST (63.3 of salaries) 55%	\$85,615	\$61,104	\$24,510
TOTAL	\$675,596	\$670,352	\$5,243
G. Tech. Subcontract	\$19,278	\$19,278	\$0
GRAND TOTAL	\$694,873	\$689,630	\$5,243

Note the overhead and fringe benefits rates in effect in 1992 are 55 % and 26.29 %, (63.3 % and 20.77 %, respectively were in effect when the proposal was submitted).



2. Explanation of variances. Highlight amount of carry-over funds.

**A Project Management**

Since the funding started late the project director was paid for only ten months instead of twelve, and the administrative assistant was paid for only 8.5 months instead of 12.

**B Principal Investigators**

Dr. Moghazy had to be given release time in the Fall 1992 semester to setup and run the Instron and train students and investigators in the use of the Instron facility.

**C. New Faculty Salaries**

Dr. John Hurley has accepted an offer to join our faculty. However he will not be able to join us until spring 1993. See Section E-4.

**E. Other Senior Personnel**

As Budgeted

**F. Student Stipends**

Lower than estimated

**G. Student Tuition**

Student tuition was paid for the entire 1992-1993, academic year instead of just for the Fall 1992 semester.

**G. Scientific and Office Equipment & Maintenance**

We have substituted a Dynamic Modulus Tester in place of Holographic Interferometry Instrumentation based upon changes in center investigators. A GPC had to be ordered in the Fall 1992 to be available for use by the HiPPAC PIs starting in January 1993.

**H. Travel (Domestic)**

The cost of travel for the External Advisory Committee was less than estimated because some of the members were able to provide for their own travel this year. However, this was partially compensated by some of the PIs and Director making trips requested by NASA to Washington for a meeting with NASA representatives and trips to NASA installations.



**I. Workshops**

As Budgeted

**J. Pre-College Programs**

As Budgeted

**Other Direct Costs**

Lower than estimated

**Carryover: \$5,243**

3. Total amount billed by university to NASA by invoice number, invoice date.

Funds were requested by electronic transfer as follows:

Date of Request	Amount
June 12, 1992	\$175,000
October 16, 1992	\$210.000





## **G. APPENDICES**

<b>Appendix 1</b>	Publicity of the Center
<b>Appendix 2</b>	NASA Steering Committee Meeting
<b>Appendix 3</b>	Progress Reports for NASA-JPL Projects Experimental Measurement of the Physical and Mechanical Properties of a Polarization Maintaining Optical Fiber
<b>Appendix 4</b>	Abstract of Funded and Pending HiPPAC Related Proposals
<b>Appendix 5</b>	"A Forum on Undergraduate Research Experiences of Minority Science, Mathematics and Engineering Students and A Workshop on Graduate School Opportunities" Abstracts of Student Poster Presentations
<b>Appendix 6</b>	"A Forum on Undergraduate Research Experiences of Minority Science, Mathematics and Engineering Students and A Workshop on Graduate School Opportunities" Abstracts of Student Poster Presentations Supplement
<b>Appendix 7</b>	"A Forum on Undergraduate Research Experiences of Minority Science, Mathematics and Engineering Students and A Workshop on Graduate School Opportunities" List of Participants
<b>Appendix 8</b>	HiPPAC Seminar Announcements
<b>Appendix 9</b>	Agenda and Minutes of Advisory Committee Meetings
<b>Appendix 10</b>	HiPPAC Fellowship Application Contract, Sample Tracking Screens, etc.
<b>Appendix 11</b>	Resume of Drs. Hurley and Turner



# **APPENDIX 1**

## **Publicity of the Center**

**Also see Appendix 4 and 5**



Jet Propulsion Laboratory  
California Institute of Technology  
4800 Oak Grove Drive  
Pasadena, California 91109-8099  
(818) 354-4321



November 6, 1992  
Refer: 109-92:MIO-1095

Dr. Kofi Bota  
Vice President of Research & Sponsored Programs  
Clark Atlanta University  
James P. Brawley Drive  
Atlanta, GA 30314

Dear Dr. Bota:

I am enclosing a Press Release regarding JPL's interface with Clark Atlanta University and the newly established HiPPAC Research Center. I would like to request that you offer this release for publication in the University's newspaper, and any other local news vehicle which you feel is appropriate.

If you have any questions, please feel free to contact me at (818) 354-2326.

Thank you for your consideration of my request.

Sincerely,

A handwritten signature in cursive script, appearing to read "Yvonne B. Freeman".

Dr. Yvonne B. Freeman  
Manager, Minority Science and Engineering  
Initiatives Office



## JPL Press Release

Clark Atlanta University (CAU) is a private, coeducational institution of predominantly African American heritage, formed July 1, 1989 by the consolidation of Atlanta University (founded 1865) and Clark College (founded 1869). It is fully accredited by the Southern Association of Colleges and Schools. The University offers undergraduate, graduate and professional degrees, as well as non-degree programs to students of diverse racial, ethnic and socioeconomic backgrounds. CAU is one of only two private historically black comprehensive universities in this country that awards the doctorate degree in three or more disciplines. CAU, disturbed by the underrepresentation of minorities in science and engineering, has positioned itself for definitive action. Through discussions among administrators, department heads, and faculty members in the natural sciences, mathematics and computer science, CAU has committed itself to initiatives to achieve distinction in training minority scientists, engineers, mathematicians, and computer scientists who will go on to receive Ph.D. degrees. This is a logical step given CAU's mission and documented historical contribution in addressing the lack of minority participation in education at the college and university level.

CAU has established a High Performance Polymers And Ceramics (HiPPAC) Research Center with major funding from NASA. The HiPPAC Center will consolidate and expand existing polymer and ceramic research capabilities through the development of interdepartmental and interinstitutional research clusters. The Center will develop strong interactions between CAU scientists and materials scientists from sister institutions in the Atlanta University Center (AUC) and the Georgia Institute of Technology. Funding from NASA will be used in part for the acquisition of major equipment, instrumentation, faculty and staff to build capacity and for student support to carry out competitive research in these areas. The Center will also develop strong collaborations with scientists from other universities and the HBCUs, national and federal agency laboratories, and the private sector.

CAU has been awarded a competitive research contract through the Minority Science and Engineering Initiatives Office of the NASA-Jet Propulsion Laboratory (JPL). This research involves the experimental measurement of the physical and mechanical properties of a polarization-maintaining optical fiber. This new fiber has been chosen by NASA-JPL for application in an advanced spacecraft inertial unit (IRU) designated as a fiber optic rotation sensor (FORS), and reliability issues regarding long term unattended use of this new fiber on spacecraft missions are being addressed in this research. A commercial single-mode optical fiber is being used as a control for all mechanical and physical testing. The stress-strain curve of the polarization-maintaining optical fiber is being measured for both jacketed and unjacketed fiber samples using an Instron Mechanical Testing Machine acquired through CAU's HiPPAC Center. Nondestructive evaluation (NDE) using sonic modulus is also being conducted. X-ray analysis is being used to monitor possible changes in the amorphous/crystalline content of the polarization maintaining optical fibers as a result of mechanical testing.

The Technical Advisor on this research effort is Dr. Ed Cuddihy who works in the Electronics Parts Reliability Section, Failure Analysis Group. Larry Wright is the Section Manager.





## **APPENDIX 2**

### **NASA Steering Committee Meeting**





National Aeronautics and  
Space Administration

Washington, D.C.  
20546

SEP 17 1992

Reply to Attn of:

RJH

Dr. Eric A. Mintz  
Department of Chemistry  
Clark Atlanta University  
223 James P. Brawley Drive  
Atlanta, GA 30314-4318

Dear Dr. Mintz:

As we discussed on the telephone, the NASA Steering Committee for the High Performance Polymers and Ceramics Research Center at Clark Atlanta University (CAU) plans to conduct a review of the Center's progress and plans for the coming year on Monday, October 19. The Committee members include:

Mr. Stephen G. Moran, Chairman	Headquarters
Dr. Seth R. Marder	Jet Propulsion Laboratory
Dr. Terry L. St. Clair	Langley Research Center
Dr. Michael A. Meador	Lewis Research Center
Dr. Frances I. Hurwitz	Lewis Research Center
Dr. Benjamin G. Penn	Marshall Space Flight Center

A list of the Steering Committee members' addresses and phone numbers is contained in the Attachment.

Although this is a formal program review, we would like to keep the proceedings as informal as possible, as our major intent is to help guide your future research efforts in directions that can benefit both the faculty and students at CAU, as well as, NASA. In addition to programmatic issues such as financial and management status of the Center, we would like for you to review the status of your stated goals of

- The acquisition of major equipment and instrumentation;
- Addition of new faculty and staff;
- Capacity building; and
- Student support to carry out competitive research in High Performance Polymers and Ceramics.



We would like to reserve the afternoon for technical discussions with the Principal and Co-Investigators concerning research to-date and future research directions in the areas of polymer and ceramic synthesis, processing, and properties. A working lunch might also be appropriate so that informal discussions can be held between the Steering Committee members and the PIs/CIs.

We should arrive by 9:00 am on Monday, and we'd like to conclude the review by about 3:00 pm. We'll leave the agenda up to you.

We look forward to spending the day with you and your researchers in the HiPPAC Center, and we hope this review will be of benefit to both CAU and NASA.

Sincerely,

A handwritten signature in black ink, appearing to read "Stephen G. Moran", written in a cursive style.

Stephen G. Moran

Attachment

cc: S. Marder/JPL, MS 67-201  
S. Massenberg/HQ, Code EU  
T. St. Clair/LaRC, MS 226  
M. Meador/LeRC, MS 106-1  
F. Hurwitz/LeRC, MS 49-3  
B. Penn/MSFC, Org. ES74, Bldg. 4481



**NASA Steering Committee  
Clark Atlanta University  
High Performance Polymers and Ceramics Research Center**

Dr. Frances I. Hurwitz  
Mail Stop 106-1  
NASA Lewis Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
(216) 433-5503

Dr. Seth R. Marder  
Mail Stop 67-201  
Jet Propulsion Laboratory  
California Institute of Technology  
4800 Oak Grove Drive  
Pasadena, CA 91109  
(818) 354-2277

Dr. Michael A. Meador  
Mail Stop 49-3  
NASA Lewis Research Center  
21000 Brookpark Road  
Cleveland, OH 44135  
(216) 433-9518

Mr. Stephen G. Moran (Chairman)  
NASA Headquarters  
Code RJH  
Washington, DC 20546  
(202) 453-2722

Dr. Benjamin G. Penn  
Organization ES74, Building 4481  
George C. Marshall Space Flight Center  
Marshall Space Flight Center, AL 35812

Dr. Terry L. St. Clair  
Mail Stop 226  
NASA Langley Research Center  
Hampton, VA 23665  
(804) 864-4273





## **APPENDIX 3**

**Progress Reports for NASA-JPL Project**

**"Experimental Measurement of the Physical and  
Mechanical Properties of a Polarization-  
Maintaining Optical Fiber"**





School of Arts and Sciences

# CLARK ATLANTA UNIVERSITY

November 30, 1992

Mr. Edward F. Cuddihy  
Group Supervisor, Failure Analysis Group  
Electronic Parts Reliability Section  
Mail Stop 300-314  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
Pasadena, CA 91109-8099

**Subject: Progress Report on Fiber Testing of Polarization-Maintaining Optical Fiber**

Dear Ed:

Enclosed are some raw data and summary data highlighting work done to date on the project. The data is presented by area of effort e.g., mechanical testing, sonic modulus, x-ray, etc. An additional progress report will follow in about two weeks completing pieces that are not complete at this time.

A draft of a renewal proposal will be sent to you in about a week and will discuss effort for a possible phase II project.

## Mechanical Testing

Control fiber with jacket	Modulus	$8.49 \times 10^6$ Psi (Ave of 10 runs)
Panda V4 with jacket	Modulus	$6.52 \times 10^6$ Psi (Ave of 10 runs)
C-Stripped Panda V4	Modulus	$8.43 \times 10^6$ Psi (Specimen #2)
M-Stripped Panda V4	Modulus	$6.32 \times 10^6$ Psi (Ave of 6 runs)

C=Chemical  
M=Mechanical

The stripped panda fiber was chemically stripped in sulfuric acid at 80-90 °C for approx. 2 minutes followed by a hexane rinse. Note the improvement in the value of the modulus for chemically stripped compared to mechanical stripped and PV-4 with

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jacket. Calculations still in progress. Mechanically tested chemically stripped samples are enclosed.

Arranging to use a UV lamp to cure DeSolute polymer on chemically stripped panda fibers for mechanical testing.

### Sonic Modulus

Conversion from gm/cm s<sup>2</sup> to Psi Multiply by  $1.45 \times 10^{-5}$

No difference in values of sonic modulus between the two different machines used is observed.

Sonic modulus without jacket appears to be 3 times larger than with jacket intact. Insufficient data at this time to draw a firm conclusion. Problems with the sample breaking during the test were severe. This is probably due to the transducers rubbing and damaging the unprotected silica cladding (Page 10 of raw data for control fiber). We are trying to determine a rules of mixture for the modulus in the presence of the jacket.

Two graphs of sonic modulus as a function of load:

Figure 1 Panda V4 with jacket  
Figure 2 Control with jacket

Still examining to see if any information can be discerned concerning the proportional limit.

### Chemical Stripping Procedure

Concentrated H<sub>2</sub>SO<sub>4</sub> with stirring

Temp °C	Time (min)
45	3.5
75	3.0
92	0.5

All fibers were removed from the acid cleanly stripped, followed by a hexane rinse. Fibers sent to you earlier.



## **X-ray Analysis**

Control fibers with jacket as a function of load are being examined in both the transmission and reflection mode. Fibers were loaded to 2 lbs, 4 lbs, 6 lbs, and 8 lbs. Results to follow shortly.

## **Birefringence**

Scheduled to use the interference microscope during the week of December 7, 1992 to examine index of refraction across the cross section of both control and panda fibers. Discussions with Prashant indicate that this should be feasible.

## **Creep Studies**

Please note that these are crude studies done by simply hanging a weight on the fibers and measuring any extension with a ruler and the naked eye.

Starting length in all cases was 12 cm. Problems with the grips was encountered.

### **Control fiber**

500 gm broke overnight (no problem for about three hours before being left unattended, no extension found prior to leaving).

1 Kg broke after approx 30 minutes

2 Kg broke immediately

### **Panda fiber**

200 gm started on 11/18/ 92 and not broken yet (11/30/92). No extension observed with ruler measurement

1 Kg broke immediately

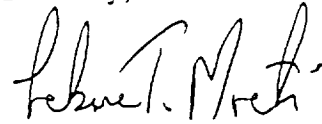
2 Kg broke immediately





I will call you shortly once you have had a chance to look over the data. Another progress report will be sent to you in about two weeks with more data analysis and interpretation. Best regards.

Sincerely,

A handwritten signature in black ink, appearing to read 'Lebone T. Moeti'. The signature is fluid and cursive, with the first name 'Lebone' being more prominent.

Lebone T. Moeti, Ph.D.  
Assistant Professor and  
Senior Research Scientist



CONTROL FIBER + Jacket

Data obtained from calculating 10 runs.

SAMPLE DESCRIPTION	DISPLACEMENT AT MAX. (in)	LOAD AT MAX. (lbs)	CALCULATED MODULUS (psi)
Testing date:- 28 Oct 1992			
1. Control #1	0.2995	11.510	$8.210 \times 10^6$
2. Control #2	0.2876	11.310	$8.588 \times 10^6$
3. Control #3	0.3005	11.250	$8.780 \times 10^6$
4. Control #4	0.2712	10.770	$8.880 \times 10^6$
5. Control #5	0.2960	11.470	$8.412 \times 10^6$
6. Control #6	0.2628	10.450	$8.400 \times 10^6$
7. Control #7	0.2968	11.540	$8.367 \times 10^6$
8. Control #8	0.2935	11.510	$8.255 \times 10^6$
9. Control #9	0.2944	11.270	$8.873 \times 10^6$
10. Control #10	0.3011	11.290	$8.140 \times 10^6$



# Panda V4 + Jacket.

ID: PANDAI & test = 28 Jul 92  
Calculation: Page 25 - Al-Amin.

Sample #	Displacement at max. (inch)	load at max. (lb)	calculated modulus (PSI)
1	.5140	1.149	$6.04214 \times 10^6$
2	.0590	0.9753	$6.52227 \times 10^6$
4	.5507	1.0850	$6.339937 \times 10^6$
5	.4659	.9938	$6.311883 \times 10^6$

ID: PANDAI & Test: 28 Jul 1992  
Calculation: Page 27 - Al-Amin.

1	.0479	.8577	$7.0132 \times 10^6$
3	.7397	.9212	$6.23227 \times 10^6$
5	.6936	1.0420	$5.84433 \times 10^6$
6	.4717	.9291	$6.99917 \times 10^6$
7	.5429	1.028	$6.79278 \times 10^6$
8	.5303	.9871	$7.12632 \times 10^6$



PV 4  
MECHANICAL STRIPPED FIBERS (JPL)

SAMPLE  
DESCRIPTION

DISPLACEMENT  
AT MAX. (in)

LOAD AT  
MAX. (lbs)

CALCULATED  
MODULUS (psi)

Testing date  
14 Oct 92

1. Mechanically  
stripped PV-4  
water washed.

0.0371  
0.0438

1.3050  
1.5180

$6.572 \times 10^6$   
 $6.400 \times 10^6$

Testing date  
13 Oct 92

2. Mechanically  
stripped PV-4  
Hexane rinsed.

*.0002*  
0 ~~.4020~~  
0 ~~.2920~~ *.0292*  
0.0353  
0.0167  
0.0371  
0.0334

1.3520  
1.004  
1.2450  
0.5091  
1.2870  
1.1340

$6.650 \times 10^6$   
 $6.268 \times 10^6$   
 $6.607 \times 10^6$   
 $6.506 \times 10^6$   
 $5.825 \times 10^6$   
 $6.100 \times 10^6$





PV 4  
**MECHANICAL STRIPPED FIBERS (JPL)**

SAMPLE DESCRIPTION	DISPLACEMENT AT MAX. (in)	LOAD AT MAX. (lbs)	CALCULATED MODULUS (psi)
Testing date 14 Oct 92			
1. Mechanically stripped PV-4 water washed.	0.0371 0.0438	1.3050 1.5180	6.572x10 <sup>6</sup> 6.400x10 <sup>6</sup>
Testing date 13 Oct 92			
2. Mechanically stripped PV-4 Hexane rinsed.	0.0420 0.2920 0.0353 0.0167 0.0371 0.0334	1.3520 1.004 1.2450 0.5091 1.2870 1.1340	6.650x10 <sup>6</sup> 6.268x10 <sup>6</sup> 6.607x10 <sup>6</sup> 6.506x10 <sup>6</sup> 5.825x10 <sup>6</sup> 6.100x10 <sup>6</sup>

**CHEMICAL RINSED FIBERS**

Testing date  
8 Sept 92

3. Stripped control fiber washed in H <sub>2</sub> SO <sub>4</sub> & Alcohol.	0.0450 0.0084	1.7430 0.2274	8.562x10 <sup>6</sup> -
4. Stripped PV-4 rinsed in H <sub>2</sub> SO <sub>4</sub> & water.	0.0568	1.6480	6.003x10 <sup>6</sup>
5. Stripped PV-4 rinsed with H <sub>2</sub> SO <sub>4</sub> & water. Then dipped in Hexane for 5mins.	0.0596	2.228	7.950x10 <sup>6</sup>
6. Stripped PV-4 rinsed in H <sub>2</sub> SO <sub>4</sub> then Alcohol washed.	0.0385	1.342	8.437x10 <sup>6</sup>



PV 4  
MECHANICAL STRIPPED FIBERS (JPL)

SAMPLE DESCRIPTION	DISPLACEMENT AT MAX. (in)	LOAD AT MAX. (lbs)	CALCULATED MODULUS (psi)
Testing date 14 Oct 92			
1. Mechanically stripped PV-4 water washed.	0.0371 0.0438	1.3050 1.5180	6.572x10 <sup>6</sup> 6.400x10 <sup>6</sup>
Testing date 13 Oct 92			
2. Mechanically stripped PV-4 Hexane rinsed.	0.0402 <del>0.4020</del> <del>0.2920</del> 0.292 0.0353 0.0167 0.0371 0.0334	1.3520 1.004 1.2450 0.5091 1.2870 1.1340	6.650x10 <sup>6</sup> 6.268x10 <sup>6</sup> 6.607x10 <sup>6</sup> 6.506x10 <sup>6</sup> 5.825x10 <sup>6</sup> 6.100x10 <sup>6</sup>

CHEMICAL RINSED FIBERS

Testing date  
8 Sept 92

✓ 3. Stripped control fiber washed in H <sub>2</sub> SO <sub>4</sub> & Alcohol.	0.0450 0.0084	1.7430 0.2274	8.562x10 <sup>6</sup> -
→ 4. Stripped PV-4 rinsed in H <sub>2</sub> SO <sub>4</sub> & water.	0.0568	1.6480	6.003x10 <sup>6</sup>
→ 5. Stripped PV-4 rinsed with H <sub>2</sub> SO <sub>4</sub> & water. Then dipped in Hexane for 5mins.	0.0596	2.228	7.950x10 <sup>6</sup>
6. Stripped PV-4 rinsed in H <sub>2</sub> SO <sub>4</sub> then Alcohol washed.	0.0385	1.342	8.437x10 <sup>6</sup>



FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 10/26/92

Operator name: Samesha Barnes

Sample Identification: SAMESHA

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000

Crosshead Speed (in/min): .0500

Instron Corporation

Series IX Automated Materials Testing System 1.11

Test Date: 30 Nov 1992

Sample Type: ASTM

Humidity (%): 80

Temperature (deg. F): 75

TIME 5:00 pm

TYPE OF FIBER PANDA

METHOD NUMBER 37

Dimensions:

Spec. 1 Spec. 2 Spec. 3 Spec. 4 Spec. 5

Lin. Density (den)	.12500	.12500	.12500	.12500	.12500
Spec gauge len (in)	4.0000	4.0000	4.0000	4.0000	4.0000

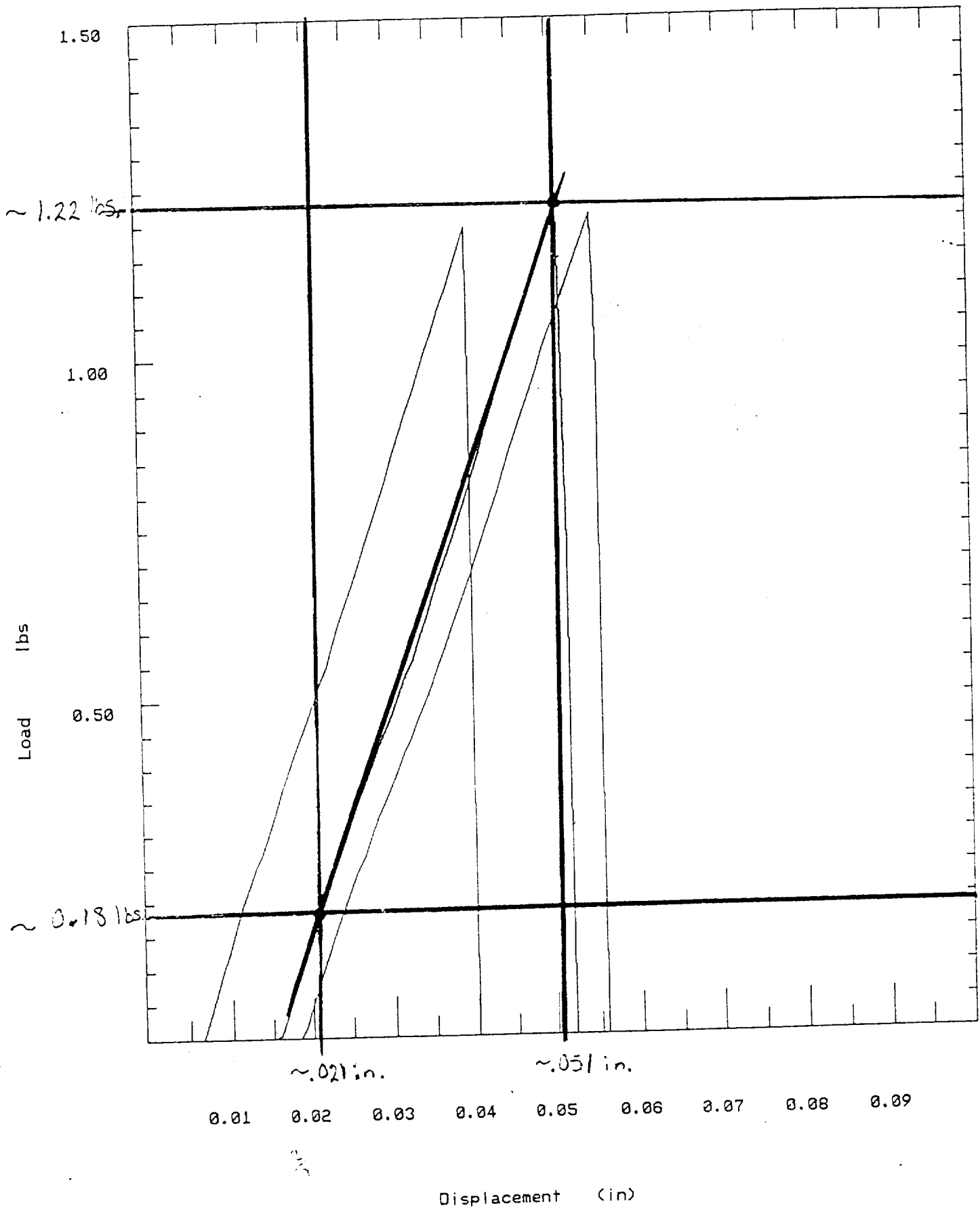
Out of 5 specimens, 0 excluded.

Specimen Number	Displcmnt at Maximum (in)	Load at Maximum (lbs)	Maximum Displcmnt (in)	Maximum Strain (in/in)
1	.0311	1.196	.0323	.0081
2	.0333	1.253	.0344	.0086
3	.0340	1.224	.0348	.0087
4	.0396	1.503	.0404	.0101
5	.0379	1.424	.0385	.0096
Mean:	.0352	1.320	.0361	.0090
Standard Deviation:	.0035	.135	.0033	.0008
Mean - 2.00 * Sdv:	.0283	1.049	.0295	.0074
Mean + 2.00 * Sdv:	.0422	1.591	.0427	.0107
Minimum:	.0311	1.196	.0323	.0081
Maximum:	.0396	1.503	.0404	.0101



SAMESHA

SPEC # 01 - 03

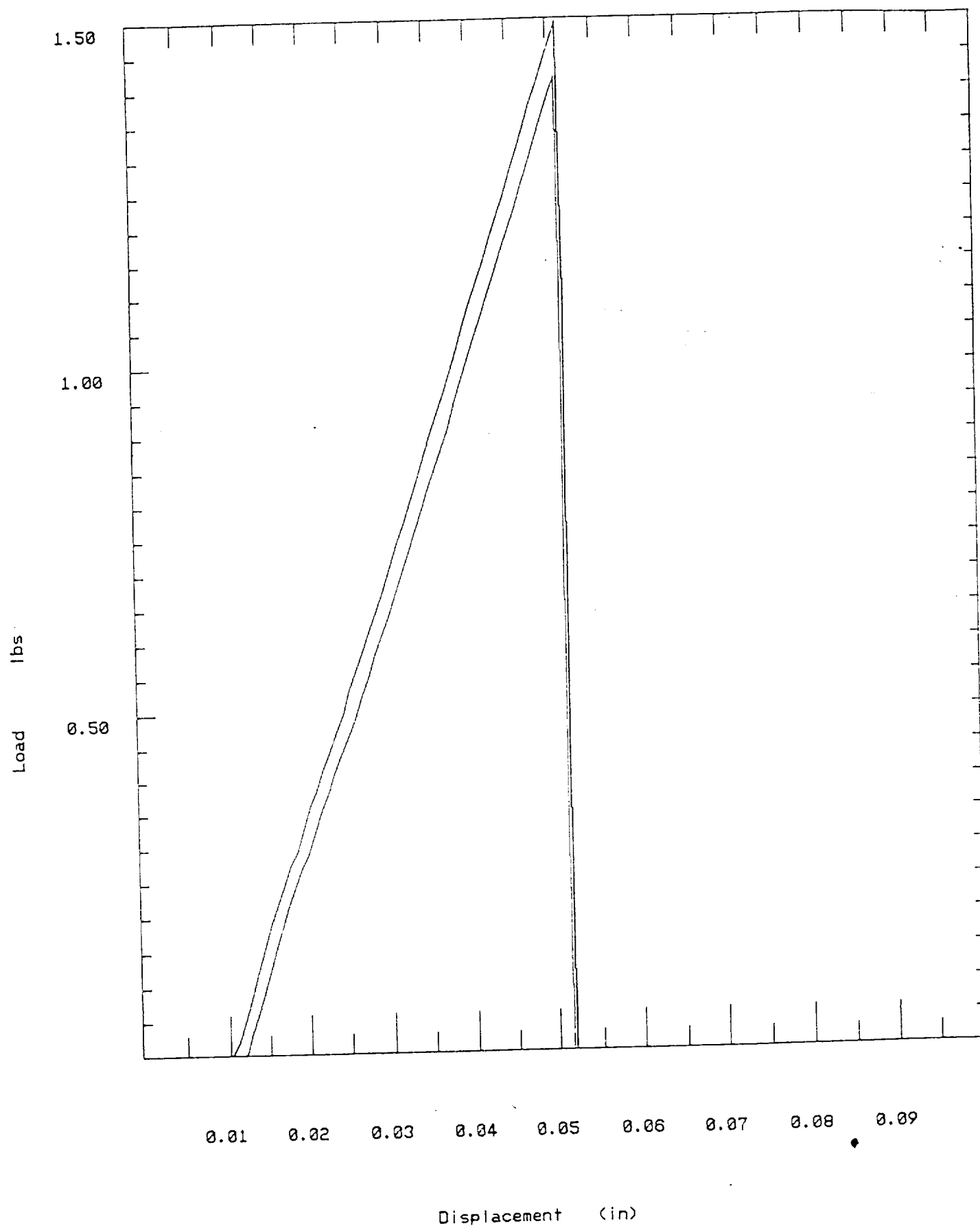






SAMESHA

SPEC # 04 - 05





Specimen #2

$$\text{Stress} = \frac{(1.22 - 0.18) \text{ lbs.}}{A} = 6.31919844 \times 10^4 \text{ psi}$$

$$\text{Strain} = \frac{(0.051 - 0.021) \text{ in.}}{4 \text{ in.}} = 0.0075$$

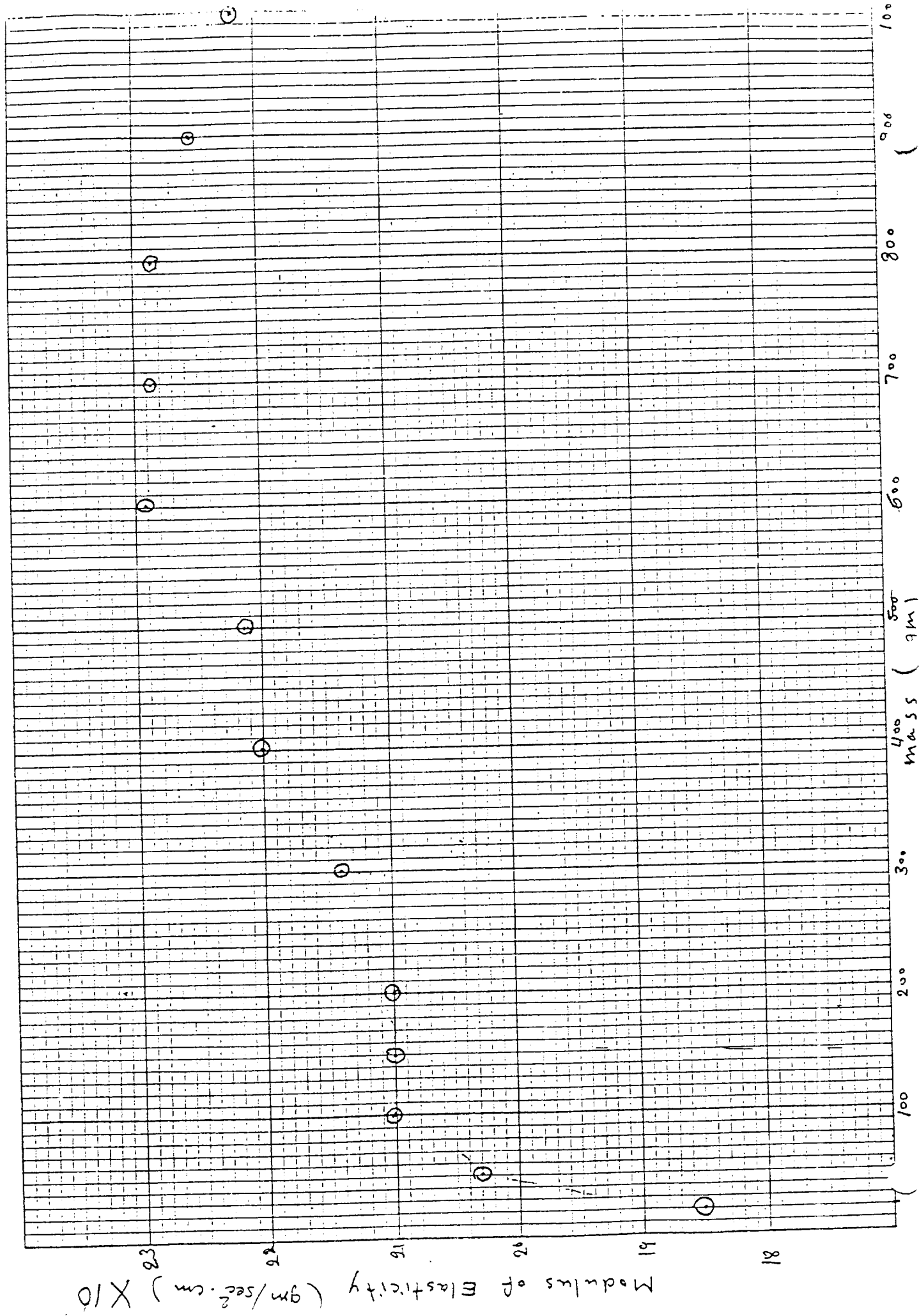
$$\text{Modulus} = \frac{\text{Stress}}{\text{Strain}} = 8.42559792 \times 10^6 \text{ psi}$$

ORIGINAL PAGE IS  
OF POOR QUALITY

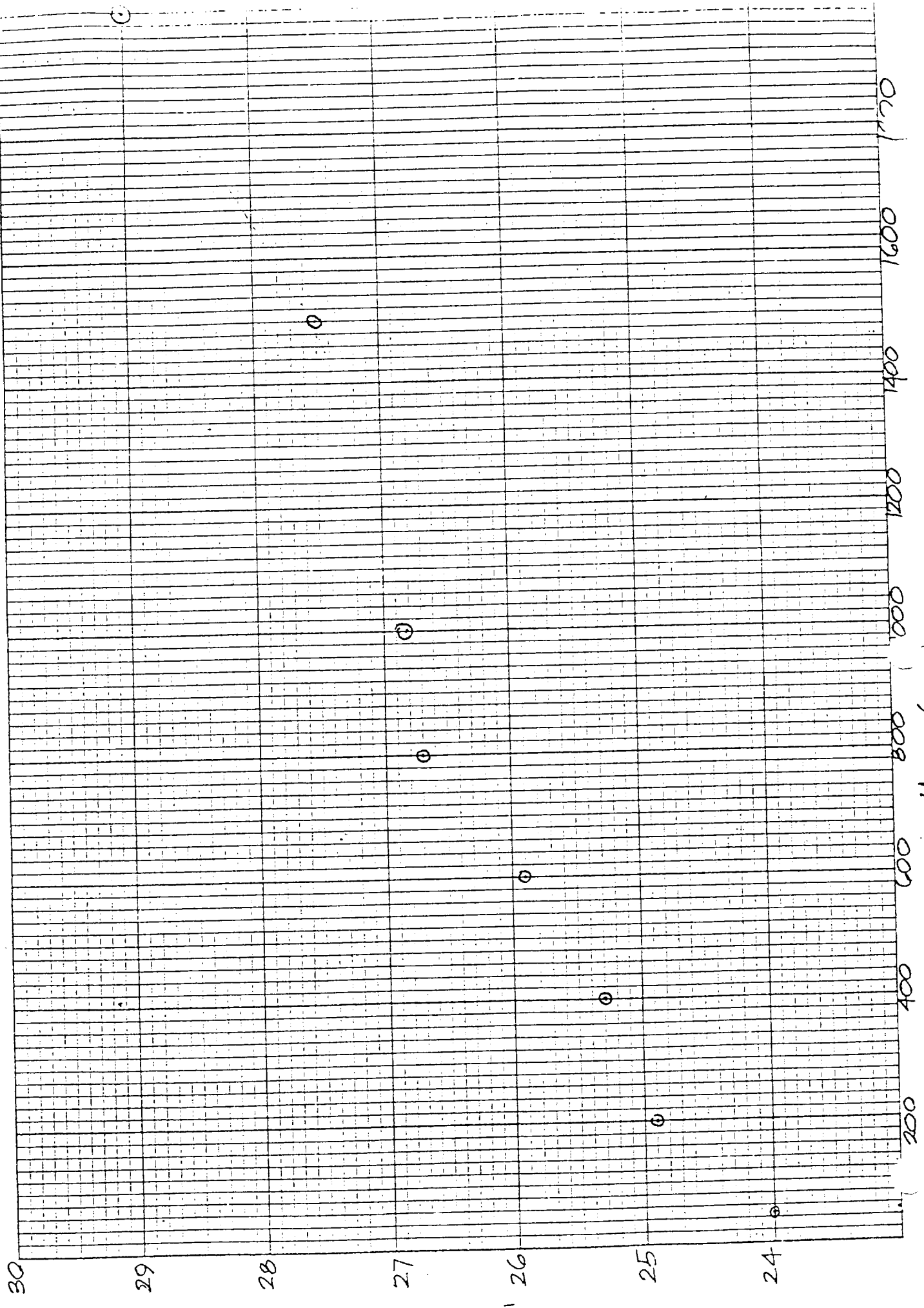




Panda V4 + Jacket.



Control + Jacket.



1

2

3



## Sonic modulus Measurements.

Control + jacket		Stripped Control H <sub>2</sub> SO <sub>4</sub> + Hexane		Panda V4 + Jacket		Stripped Panda V4 H <sub>2</sub> SO <sub>4</sub> + Hexane	
Weight gm	date	Weight	date	Weight	date	Weight	date
20				20 gm	10/22/92		
50	11/3/92	50 gm	11/3/92	50 gm	10/26		
100		100 gm	11/3/92	100	10/26		
150				150	10/28		
200	11/4/92			200	10/28		
300				300 gm	10/28		
400	11/4/92			400	10/28		
500				500	10/28		
600	11/4			600	10/28		
700				700	10/30		
800	11/4			800	10/30		
900				900	10/30		
1000	11/4			1000	10/30		
1500	11/6						
2000	11/6						



Sonic modulus - Control Sample with Jacket.

$$\text{density} = 1.5948523 \text{ gm/cm}^3$$

Control - 50 gm		Control - 200 gm		Control - 400 gm		600 gm		800 gm	
velocity	modulus	V	E	V	E	V	E	V	E
Km/sec		Km/sec		Km/sec		Km/sec		Km/sec	
• 3.848		3.969		• 3.849		4.097		• 4.097	
3.908		3.908		3.969		3.969		4.032	
• 3.848		3.908		• 3.969		4.032		• 4.097	
3.908		3.969		3.969		4.032		4.097	
• 3.848		3.969		• 3.969		4.032		• 4.097	
3.908		3.969		3.969		3.969		4.164	
• 3.848		3.969		• 3.969		4.097		• 4.164	
3.908		3.969		3.969		4.032		4.032	
• 3.848		3.969		• 3.969		4.032		• 4.233	
3.908		3.908		3.849		4.032		4.164	
• 3.848		3.969		• 4.032		4.032		• 4.032	
3.908		3.908		3.908		4.097		4.032	
• 3.848		3.969		• 4.032		4.032		• 3.969	
3.908		3.969		3.969		4.032		4.032	
• 3.848				• 4.097		4.032		• 4.032	
3.908				3.969		4.032		4.032	
• 3.848				• 3.969				• 4.097	
3.908				3.969				4.164	
• 3.848				• 3.969				• 4.164	
3.908				3.969				4.097	

Avg 3.884

3.952

3.984

4.032

4.094

$$\frac{\text{gm}}{\text{Sec}^2 \cdot \text{cm}} E 24.059 \times 10^{10}$$

$$26.059 \times 10^{10}$$

$$24.909 \times 10^{10}$$

$$25.314 \times 10^{10}$$

$$25.928 \times 10^{10}$$

$$26.705 \times 10^{10}$$

• forward direction



## Sonic modulus - Control Sample with Jacket

density = 1.5948523 gm/cm<sup>3</sup>

1000 gm

1500 gm

2000 gm

V  
Km/sec

E

V  
Km/sec

E

V  
Km/sec

E

4.097

4.164

4.233

4.097

4.164

4.305

4.097

4.164

4.097

4.097

4.164

break

4.097

4.233

4.097

4.097

4.097

4.164

4.097

4.164

4.097

4.164

4.097

4.164

4.097

break

4.97

new

4.097

sample

4.097

4.379

4.097

4.097

4.097

4.164

4.164

4.097

4.097

4.164

4.097

4.164

4.097

4.164

4.164

4.164

4.097

gm  
cm. sec<sup>2</sup>

4.1

26.309 x 10<sup>10</sup>

4.154

27.520 x 10<sup>10</sup>

4.269

29.265 x 10<sup>10</sup>



Sonic modulus -  $H_2SO_4$  stripped Control fiber (Hexane)

$$\text{density} = 2.144 \text{ gm/cm}^3$$

50 gm		100 gm							
V	E	V	E						
km/sec		Km/sec							
6.684		5.907							
6.865		5.907							
6.048		5.644							
6.048		5.907							
5.773		5.522							
6.195		6.048							
5.907		5.644							
6.35		6.048							
5.773		5.522							
6.35		6.048							
6.048		5.773							
5.773		5.907							
5.773		5.522							
5.644		5.907							
5.522		5.522							
5.644		6.048							
5.907		5.522							
5.644		6.048							
5.522		5.404							
5.644		5.907							
		5.404							
		Break							
$\frac{\text{gm}}{\text{cm} \cdot \text{sec}}$	5.971	$76.44 \times 10^{10}$	5.77	$74.38 \times 10^{10}$					





Sonic Modulus - Panda V-4 - with Jacket

009

$$\text{density} = 1.3794596 \text{ gm/cm}^3$$

800

900

1000

V  
Km/sec

E

V  
Km/sec

E

V  
Km/sec

E

3.969

4.032

4.097

3.969

4.032

4.164

3.969

4.032

4.032

3.969

4.032

4.032

4.032

4.032

3.908

3.969

4.032

4.233

4.097

4.097

4.032

4.164

4.097

4.097

4.032

4.097

4.097

4.097

4.032

$\frac{\text{gm}}{\text{cm} \cdot \text{sec}^2}$

3.980

$21.851 \times 10^{10}$

4.065

$22.571 \times 10^{10}$

4.103

$23.923 \times 10^{10}$



# Sonic modulus - Panda V-L - with Jacket

density = 1.3794596

300 gm		400		500		600		700	
V	E	V	E	V	E	V	E	V	E
Km/sec		Km/sec		Km/sec		Km/sec		Km/sec	
3.908		3.908		4.097		3.908		3.969	
3.908		3.969		4.097		3.908		3.969	
3.908		3.969		3.848		3.969		4.032	
3.908		3.969		3.969		3.849		3.969	
3.969		3.908		4.032		4.032		3.969	
3.969		3.791		4.164		3.908		3.908	
3.908		3.969		4.032		3.969		3.969	
3.908		3.969		3.969		4.032		4.032	
3.908		3.969		3.969		3.969		3.969	
4.032		3.969		3.969		4.032		3.969	
3.908		3.969		3.969		3.969		3.969	
3.908		3.969		4.097		3.908		3.969	
3.908		4.032		4.097		3.969			
3.969		4.032		3.969		3.908			
3.908		4.032		3.908					
3.908		4.032		4.032					
3.969		4.032		3.969					
3.969		4.032		3.969					
3.969		4.097		3.908					
4.097		4.097		4.097					
		4.032		3.969					
				4.032					
				4.032					
				4.032					
				4.032					
3.942	21.430x10	4.000	22.07x10		22.16x10	4.017	22.25x10	3.981	21.26x10



Sonic modulus - Panda V-11 with jacket

density = 1.3794596 gm/cm<sup>3</sup>

20 gm		50 gm		100 gm		150 gm		200 gm	
V	E	V	E	V	E	V	E	V	E
Km/sec		Km/sec		Km/sec		Km/sec		Km/sec	
3.613		3.808		3.849		3.908		3.969	
3.336		3.908		3.908		3.908		3.849	
3.7315		3.848		3.908		3.969		3.908	
3.432		3.908		3.908		3.908		3.908	
3.762		3.908		3.908		3.849		3.908	
3.623		3.908		3.908		3.849		3.908	
3.225		3.791		3.908		3.908		3.908	
3.565		3.848		3.908		3.908		3.908	
3.984		3.735		3.908		3.969		3.908	
3.834		3.791		3.908		3.849		3.908	
3.834		3.848		3.908		3.908		3.908	
3.834		3.791		3.969		3.908		3.849	
3.763		3.848		3.908		3.908		3.908	
3.834		3.908		3.908		3.908		3.908	
3.444		3.791		3.908		3.908			
3.763		3.735		3.908		3.908			
3.629		3.908		3.908					
3.908		3.791		3.849					
3.565		3.848		3.908					
3.629									
3.695									



# Relation between load and $\sigma$ & $E$

010

mass	Control + Jacket		Control - $H_2SO_4$ stripped & hexane		Pamela V-4 with Jacket	
g/m	velocity km/sec	$E \frac{gm}{cm \cdot sec^2}$	velocity km/sec	$E \frac{gm}{cm \cdot sec^2}$	velocity km/sec	$E \frac{gm}{cm \cdot sec^2}$
20					3.667	$18.547 \times 10^9$
50	3.884	$24.059 \times 10^9$	5.971	$76.44 \times 10^9$	3.844	$20.341 \times 10^9$
100			5.77	$71.38 \times 10^9$	3.905	$21.035 \times 10^9$
150				↓ break	3.905	$21.035 \times 10^9$
200	3.952	$24.909 \times 10^9$			3.904	$21.025 \times 10^9$
300					3.942	$21.436 \times 10^9$
400	3.984	$25.314 \times 10^9$			4.00	$22.071 \times 10^9$
500					4.03	$22.161 \times 10^9$
600	4.032	$25.928 \times 10^9$			4.017	$22.359 \times 10^9$
700					3.981	$21.862 \times 10^9$
800	4.098	$26.705 \times 10^9$			3.980	$21.851 \times 10^9$
900					4.045	$22.571 \times 10^9$
1000	4.100	$26.809 \times 10^9$			4.103	$23.223 \times 10^9$
1500	4.154	$27.520 \times 10^9$				↓ break
2000	4.269	$29.065 \times 10^9$				
		↓ break				









Dr. Lebone T. Moeti  
109 O & L  
Ames Laboratory  
Iowa State University  
Ames, IA 50011  
(515) 294-5556

August 18, 1992

Mr Edward F. Cuddihy  
Group Supervisor  
Failure Analysis Group  
Electronic Parts Reliability Section  
Mail Stop 300-314  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
Pasadena, CA 91109-8099

**Subject:** Progress Report on Fiber Testing of Polarization-Maintaining  
Optical Fiber

Dear Mr. Cuddihy:

Enclosed are data reporting the initial testing being done at Clark Atlanta University and the Georgia Institute of Technology. Mechanical testing, X-ray analysis, and sonic modulus are currently under way and are submitted in this report.

### **Mechanical Testing**

Problems with slippage are being encountered with both the control and panda fibers. The slippage is more severe in the case of the Panda fibers. Roller grips are being ordered to eliminate this problem and other grip configurations are being designed in consultation with Instron. The 1000 gm load cell to resolve the proportional limit in the fibers has been delivered along with the environmental chamber. A humidity chamber has



been ordered to reduce any possible slippage due to moisture on grips and fibers during testing. **CAUTION** - the values of modulus for the Panda fiber may be of the acrylic cladding with some contribution from the glass core. The slipping in this case was severe. For reliable values of modulus Panda fibers with the ends stripped off will be required as we discussed. The initial values of modulus are as follows:

Control Fiber       $1 \times 10^7$  Psi

Panda Fiber       $6 \times 10^6$  Psi (using linear portion of load  
displacement Curve)

### Sonic Modulus

For the sonic modulus a value of  $2.2 \text{ gm/cm}^3$ , the density of fused silica, was used to calculate the modulus. Experimental determination of the density of both the control and panda fiber is being conducted. The initial values of sonic modulus are as follows:

Control Fiber       $4.22 \times 10^6$  Psi

Panda Fibers       $3.90 \times 10^6$  Psi

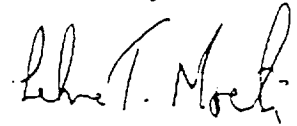
### X-ray Analysis

Preliminary indications of x-ray analysis of the control fiber show no difference in diffraction patterns between the broken and as received fibers. More tests are being conducted.

TMA and creep studies are being initiated and a second report will be prepared at the end of this month when I return to Atlanta from Ames. Please let me know if you will be in Atlanta on the 24th of August, 1992. Feel free to contact me if you have any questions.



Sincerely,

A handwritten signature in black ink, appearing to read 'Lebone T. Moeti'. The signature is fluid and cursive, with the first name 'Lebone' being more prominent.

Lebone T. Moeti  
Asst. Professor and  
Sn. Research Scient.

Enclosures

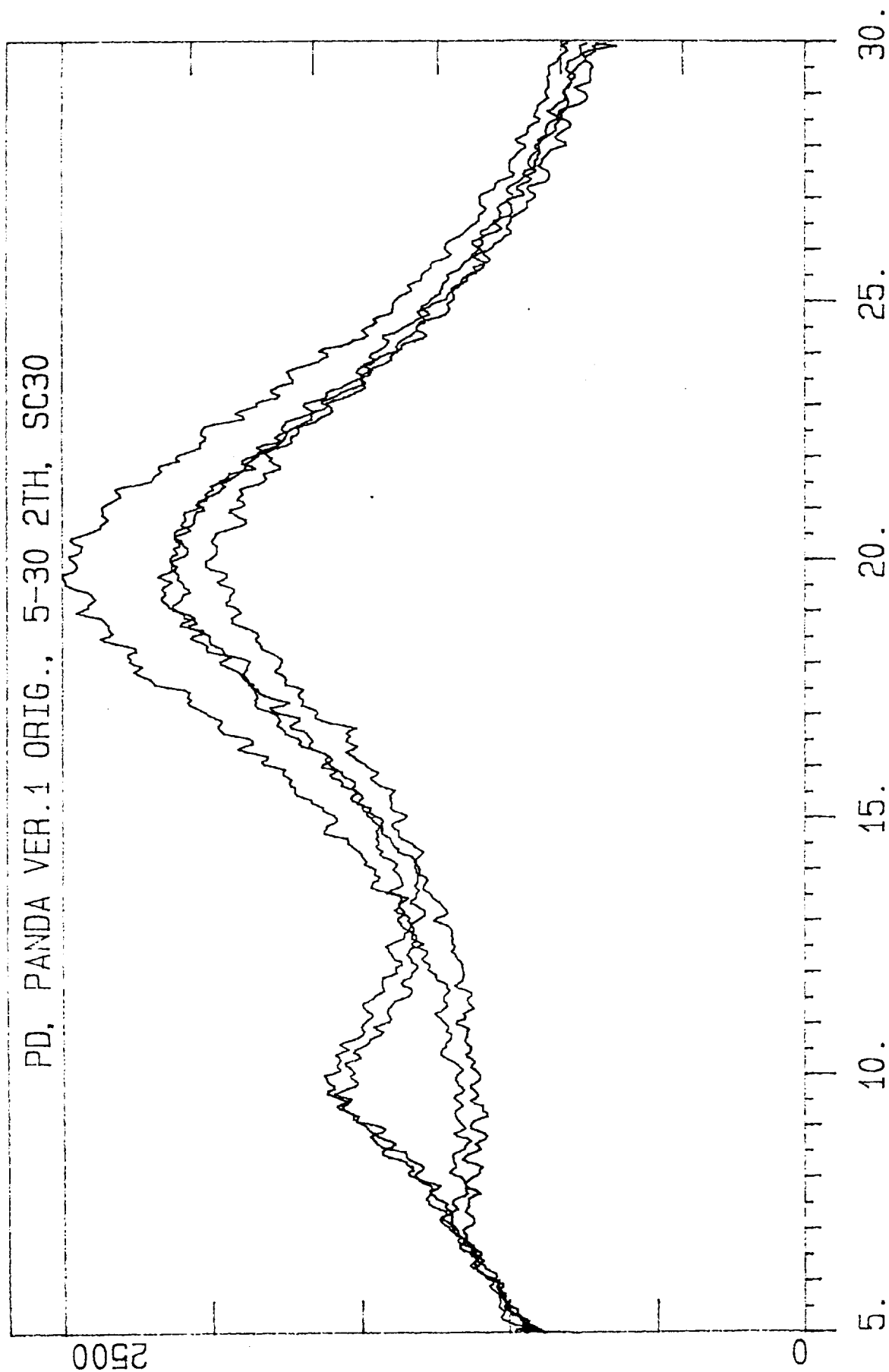






Z02129.RAW

PD, PANDA VER.1 ORIG., 5-30 2TH, SC30

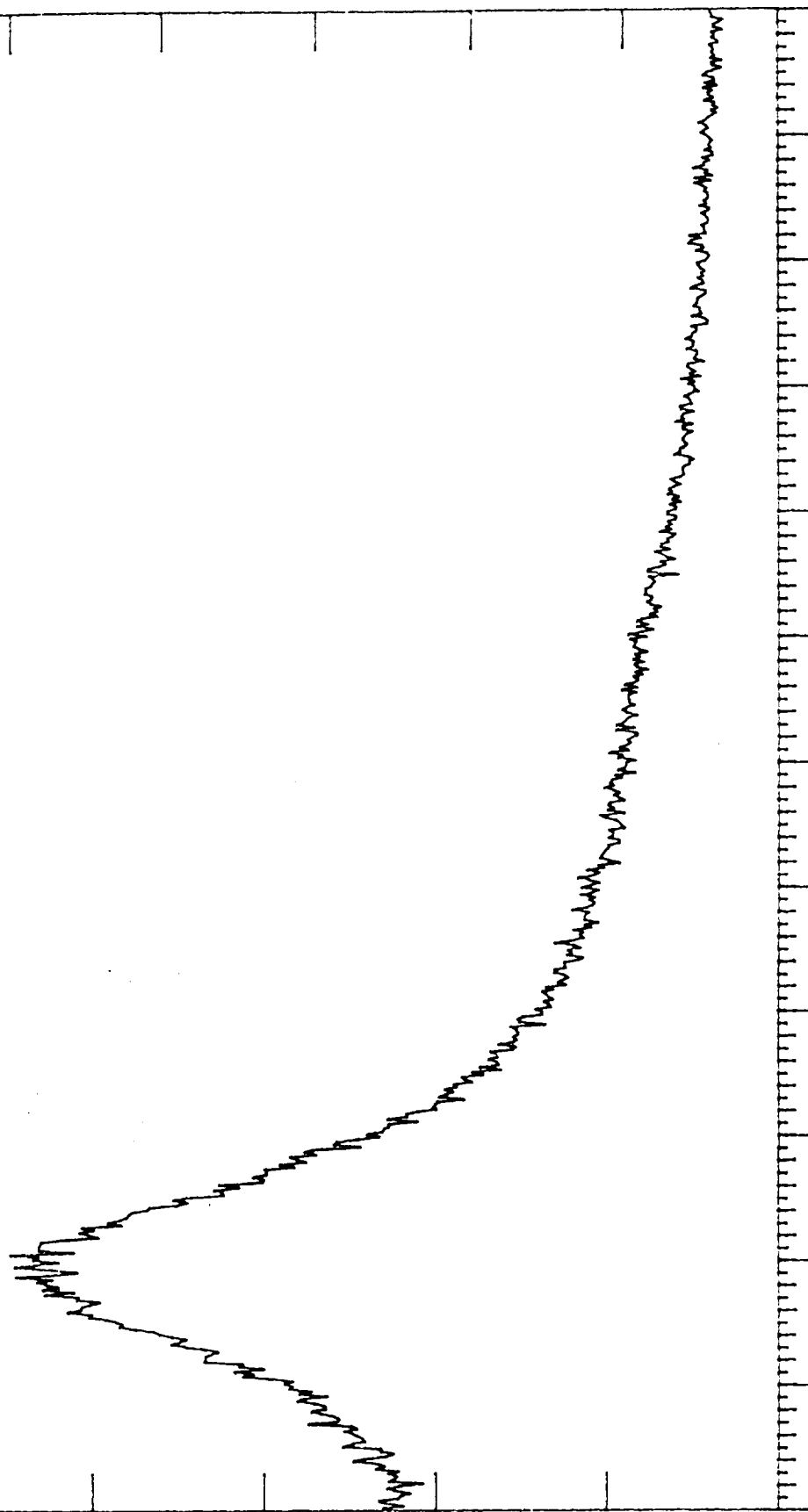


Z02123.RAW

PD, SMF-28 (TM) FIBER, 10-70 2TH, SC29

2500

0



10. 15. 20. 25. 30. 35. 40. 45. 50. 55. 60. 65. 70.

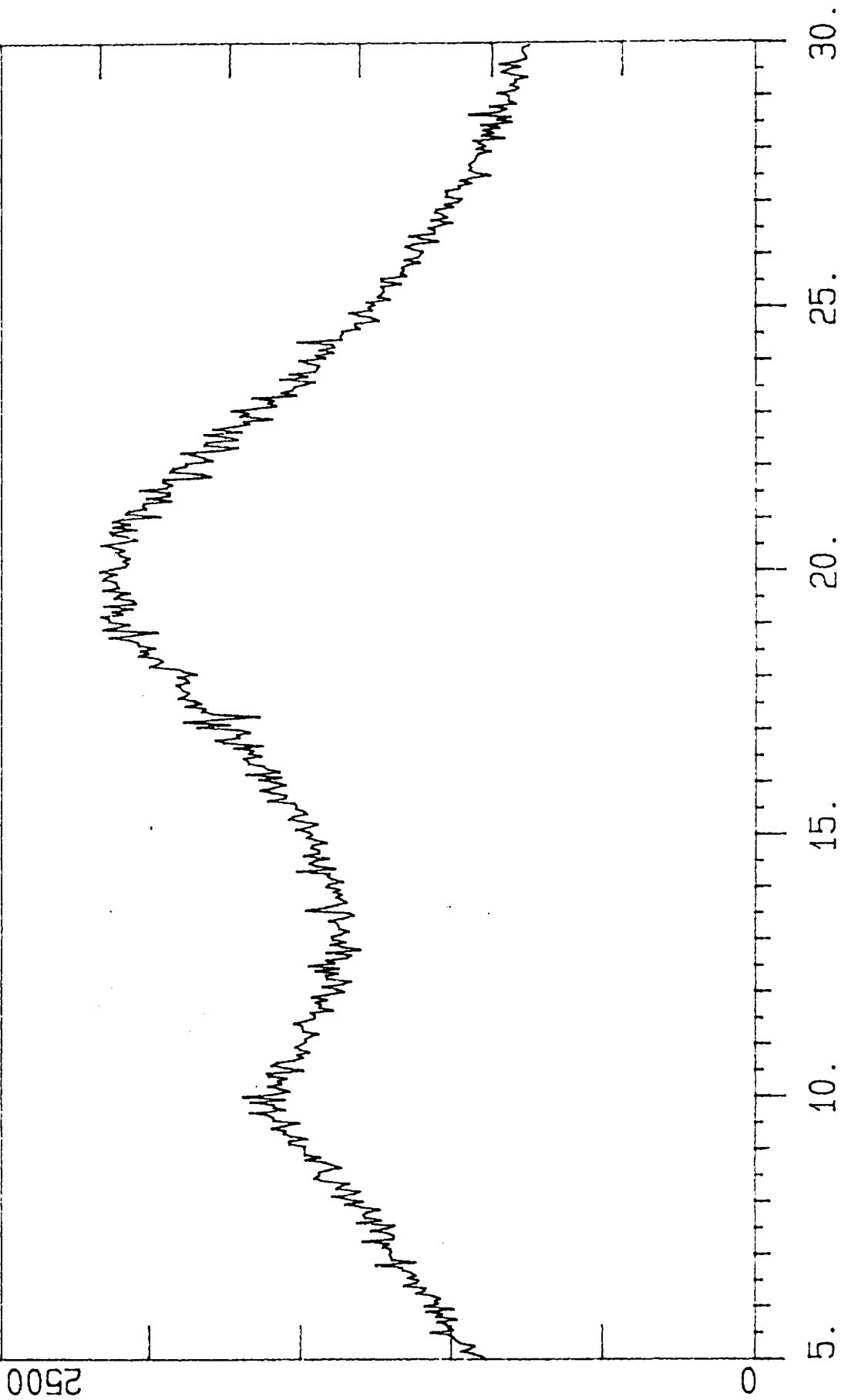
1

2

3

Z02125.RAW

PD. PANDA FIBER, 5-30 2TH, SC30

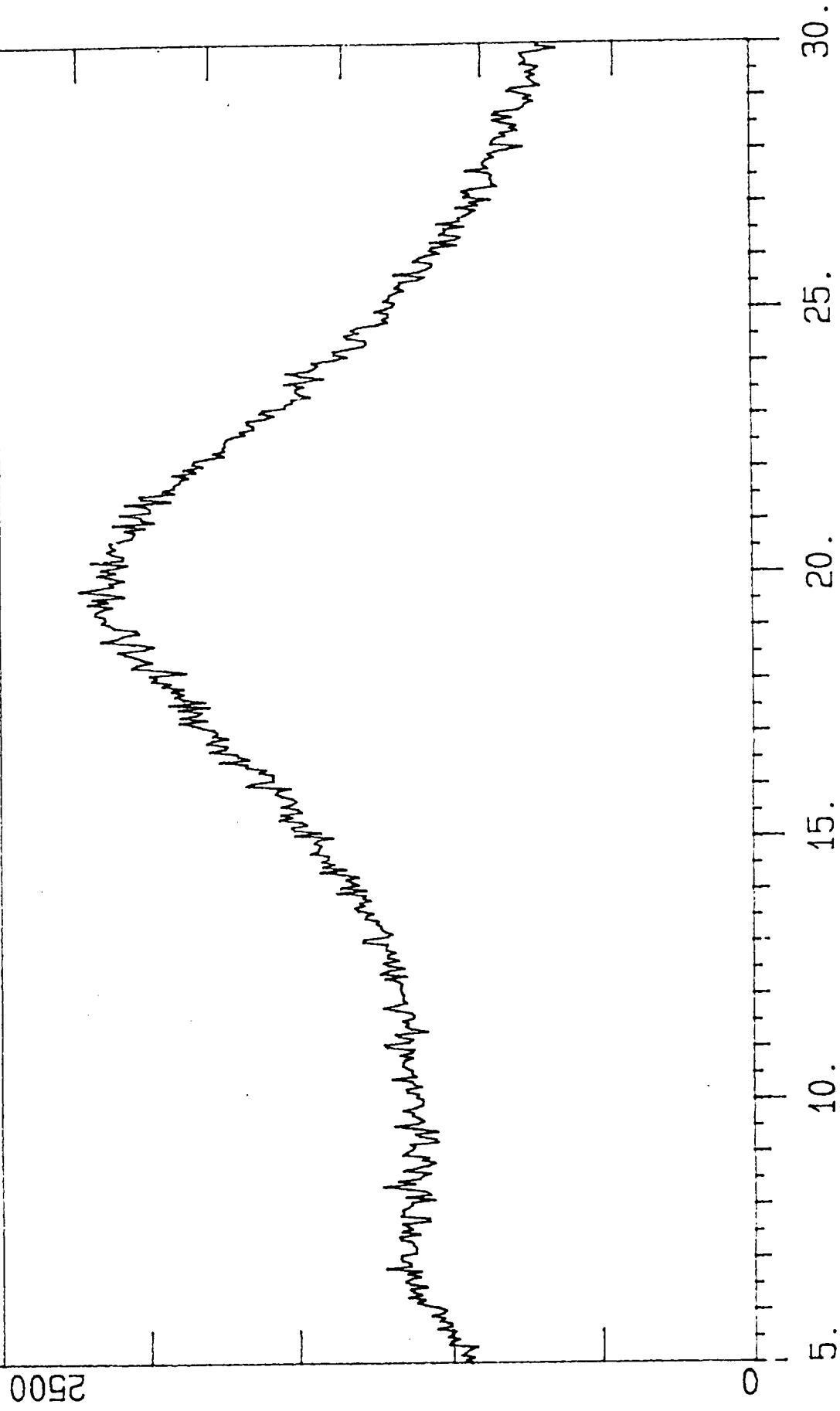


1

2

Z02124.RAW

PD, SMF--28 (TM), 5-30 2TH, SC30



—

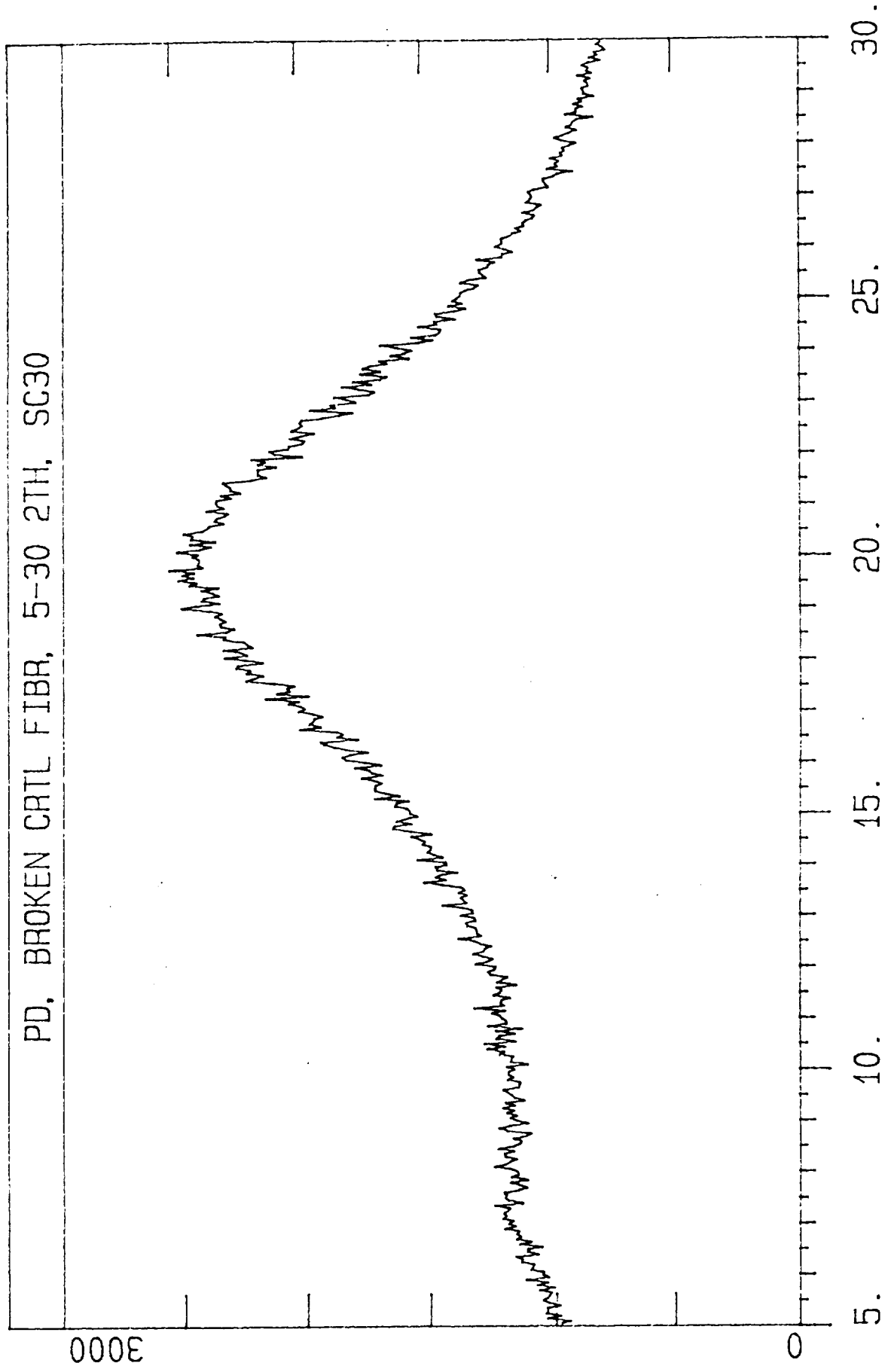
—

—



Z02127.RAW

PD, BROKEN CTRL FIBR, 5-30 2TH, SC30



1

2

3

FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 7/20/92

Operator name: AL-AMIN ALLY

Sample Identification: PANDA

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000

Crosshead Speed (in/min): .0500

Instron Corporation

Series IX Automated Materials Testing System 1.11

Test Date: 28 Jul 1992

Sample Type: ASTM

Humidity ( % ): 79

Temperature (deg. F): 73

TIME 3:50pm

TYPE OF FIBER Panda-type polarization optical fiber

Dimensions:

Spec. 1 Spec. 2

Lin. Density (den) .12500 .12500

Spec gauge len (in) 4.0000 4.0000

Out of 2 specimens, 0 excluded.

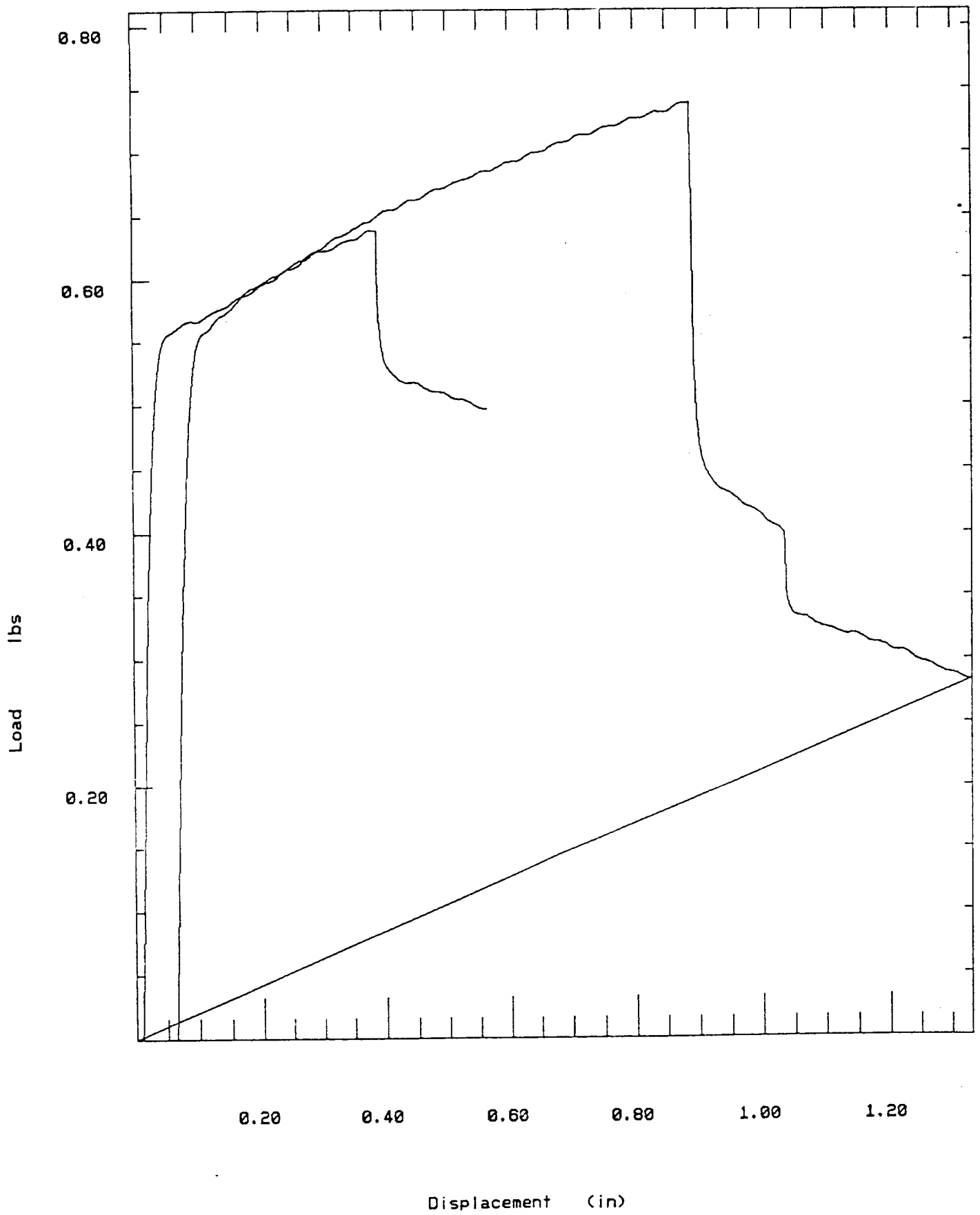
Sample comments: The Xhead was running at speed .05. Secant modulus hard to get.

| Specimen<br>Number          | Displcmnt<br>at<br>Maximum<br>(in) | Load<br>at<br>Maximum<br>(lbs) | Maximum<br>Displcmnt<br>(in) | Maximum<br>Strain<br>(in/in) |
|-----------------------------|------------------------------------|--------------------------------|------------------------------|------------------------------|
| 1                           | .8767                              | .7387                          | 1.3220                       | .3304                        |
| 2                           | .3179                              | .6390                          | .4978                        | .1244                        |
| Mean:                       | .5973                              | .6889                          | .9098                        | .2274                        |
| Standard<br>Deviation:      | .3952                              | .0705                          | .5827                        | .1457                        |
| Mean -<br>2.00 * Sdv: ***** |                                    | .5479                          | -.2555                       | *****                        |
| Mean +<br>2.00 * Sdv: ***** |                                    | .8298                          | 2.0750                       | .5188                        |
| Minimum:                    | .3179                              | .6390                          | .4978                        | .1244                        |
| Maximum:                    | .8767                              | .7387                          | 1.3220                       | .3304                        |

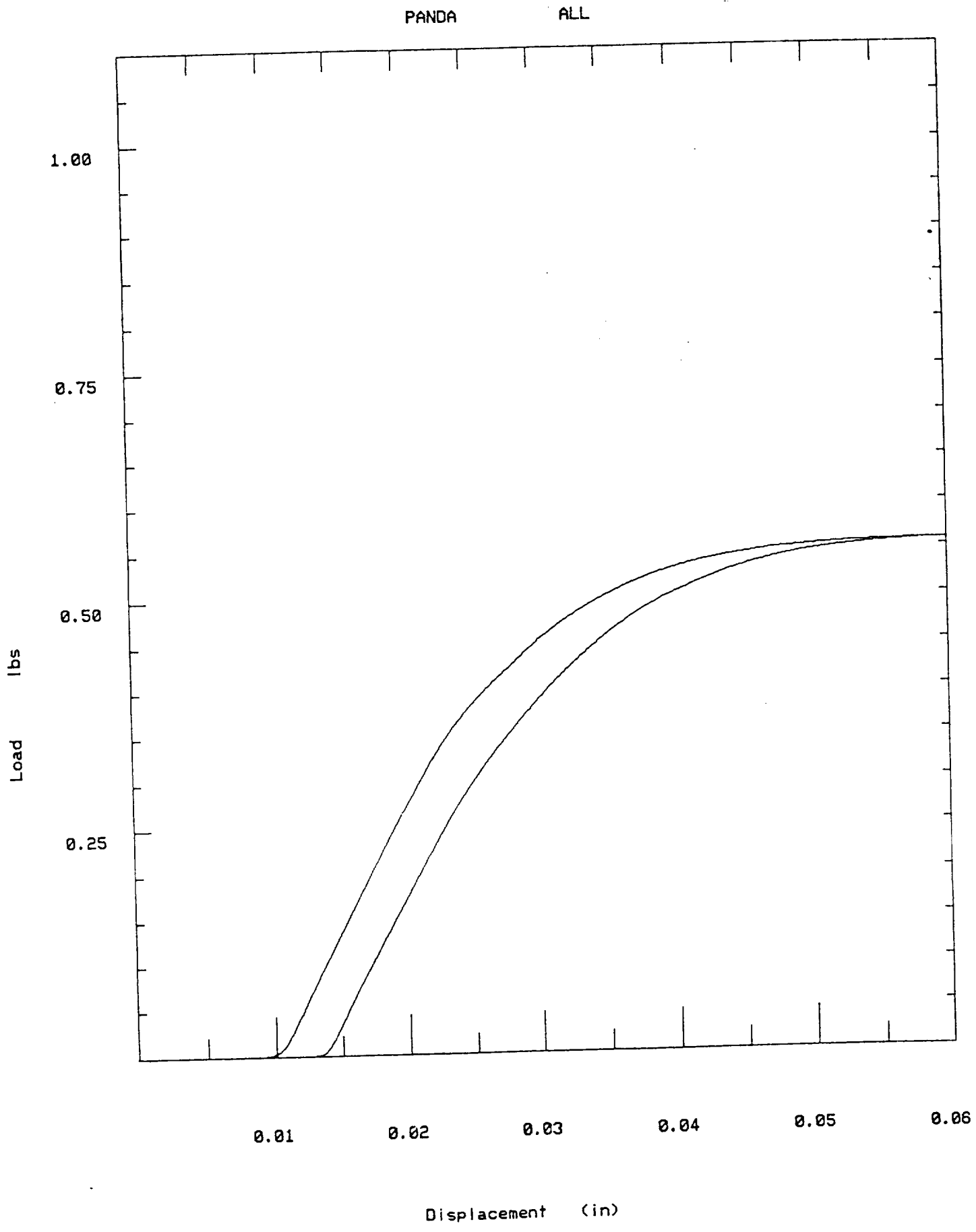


PANDA

ALL











FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 7/20/92

Operator name: Al-amin Ally

Sample Identification: PANDA3

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000

Crosshead Speed (in/min): .2000

Instron Corporation

Series IX Automated Materials Testing System 1.11

Test Date: 28 Jul 1992

Sample Type: ASTM

Humidity ( % ): 79

Temperature (deg. F): 73

TIME 3:06pm

TYPE OF FIBER Panda-type polarization fiber

Dimensions:

Spec. 1 Spec. 2 Spec. 3 Spec. 4

|                     |        |        |        |        |
|---------------------|--------|--------|--------|--------|
| Lin. Density (den)  | .12500 | .12500 | .12500 | .12500 |
| Spec gauge len (in) | 4.0000 | 4.0000 | 4.0000 | 4.0000 |

Out of 4 specimens, 1 excluded.

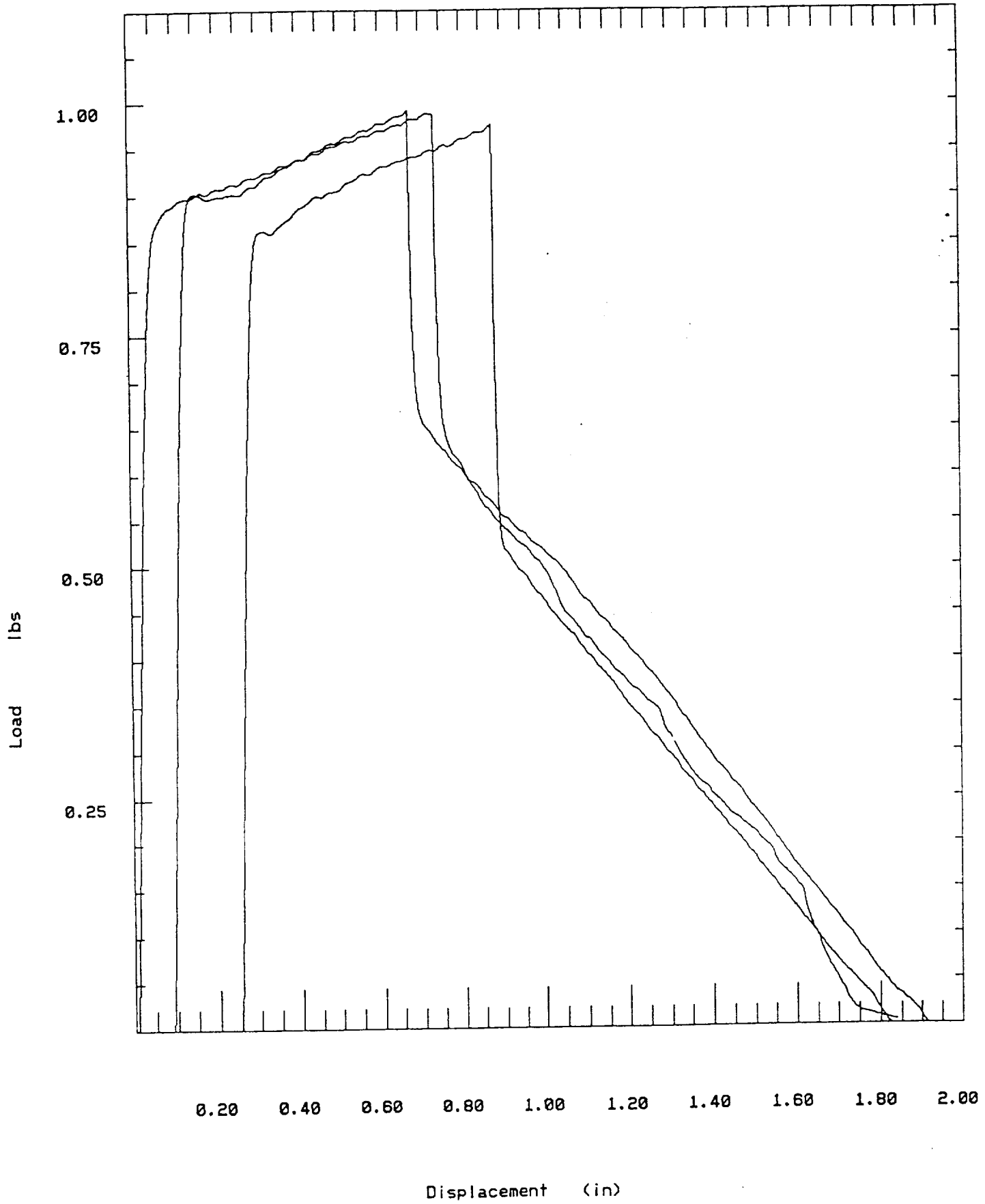
Sample comments: Excluded test was run with no sample inserted.

|                        | Displcmnt<br>at<br>Maximum<br>Specimen<br>Number<br>(in) | Load<br>at<br>Maximum<br>(lbs) | Maximum<br>Displcmnt<br>(in) | Maximum<br>Strain<br>(in/in) |
|------------------------|--|--------------------------------|------------------------------|------------------------------|
| 1                      | .7096  | .9881                          | 1.8300                       | .4576                        |
| 2                      | .5795  | .9907                          | 2.2180                       | .5544                        |
| *Excluded*             | -.0002   | -.0024                         | .0067                        | .0017                        |
| 4                      | .6248  | .9762                          | 1.6990                       | .4247                        |
| Mean:                  | .6379  | .9850                          | 1.9160                       | .4789                        |
| Standard<br>Deviation: | .0660  | .0077                          | .2697                        | .0674                        |
| Mean -<br>2.00 * Sdv:  | .5059  | .9695                          | 1.3760                       | .3440                        |
| Mean +<br>2.00 * Sdv:  | .7700  | 1.0000                         | 2.4550                       | .6137                        |
| Minimum:               | .5795  | .9762                          | 1.6990                       | .4247                        |
| Maximum:               | .7096  | .9907                          | 2.2180                       | .5544                        |



PANDA3

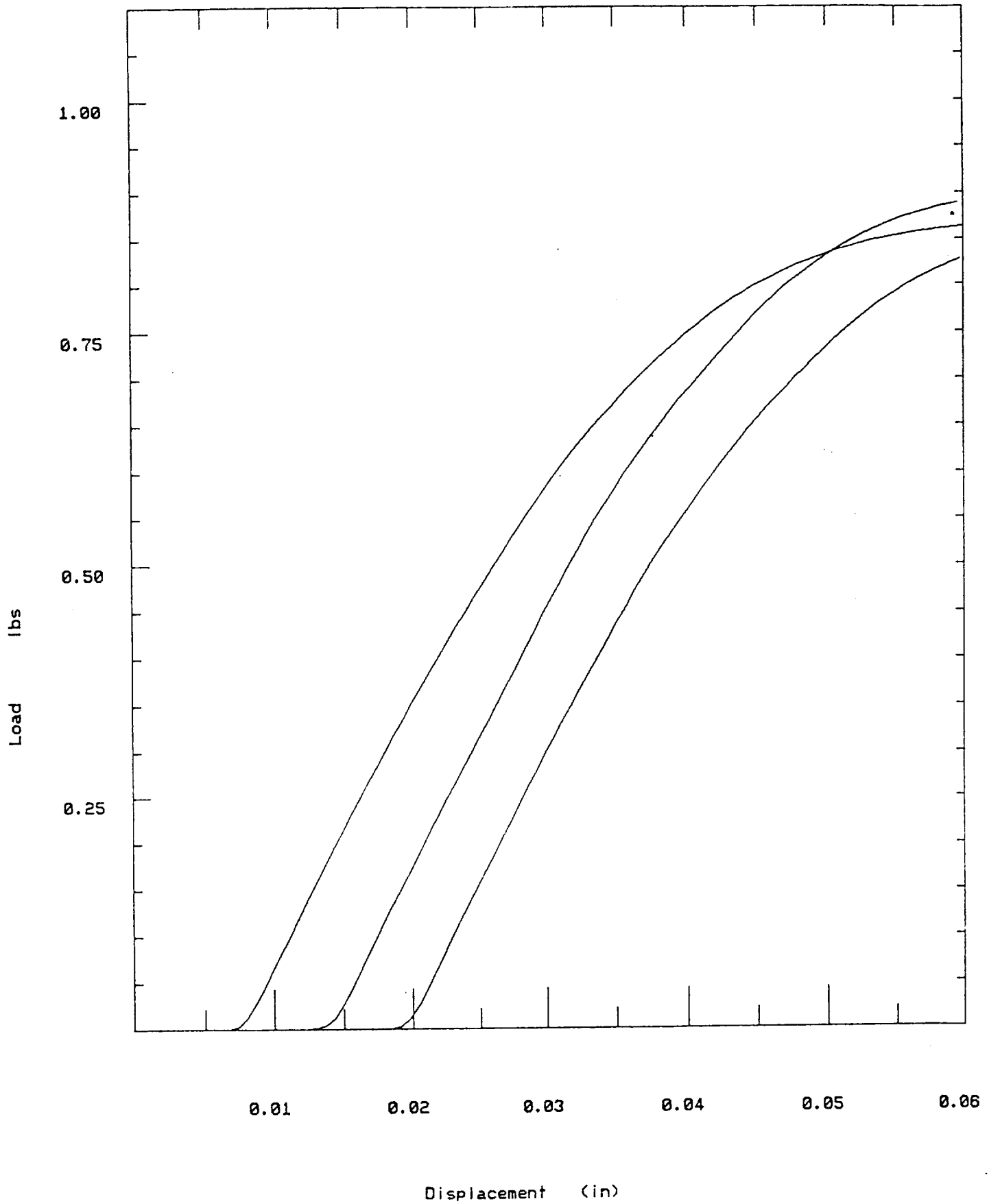
ALL





PANDA3

ALL





FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 7/20/92

Operator name: Al-amin Ally

Sample Identification: PANDA4

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000

Crosshead Speed (in/min): .2000

Instron Corporation

Series IX Automated Materials Testing System 1.11

Test Date: 30 Jul 1992

Sample Type: ASTM

Humidity ( % ): 84

Temperature (deg. F): 69

TIME 11:24 am

TYPE OF FIBER PANDA-TYPE OPTICAL FIBER

Dimensions:

Spec. 1 Spec. 2

Lin. Density (den) .12500 .12500

Spec gauge len (in) 4.0000 4.0000

Out of 2 specimens, 0 excluded.

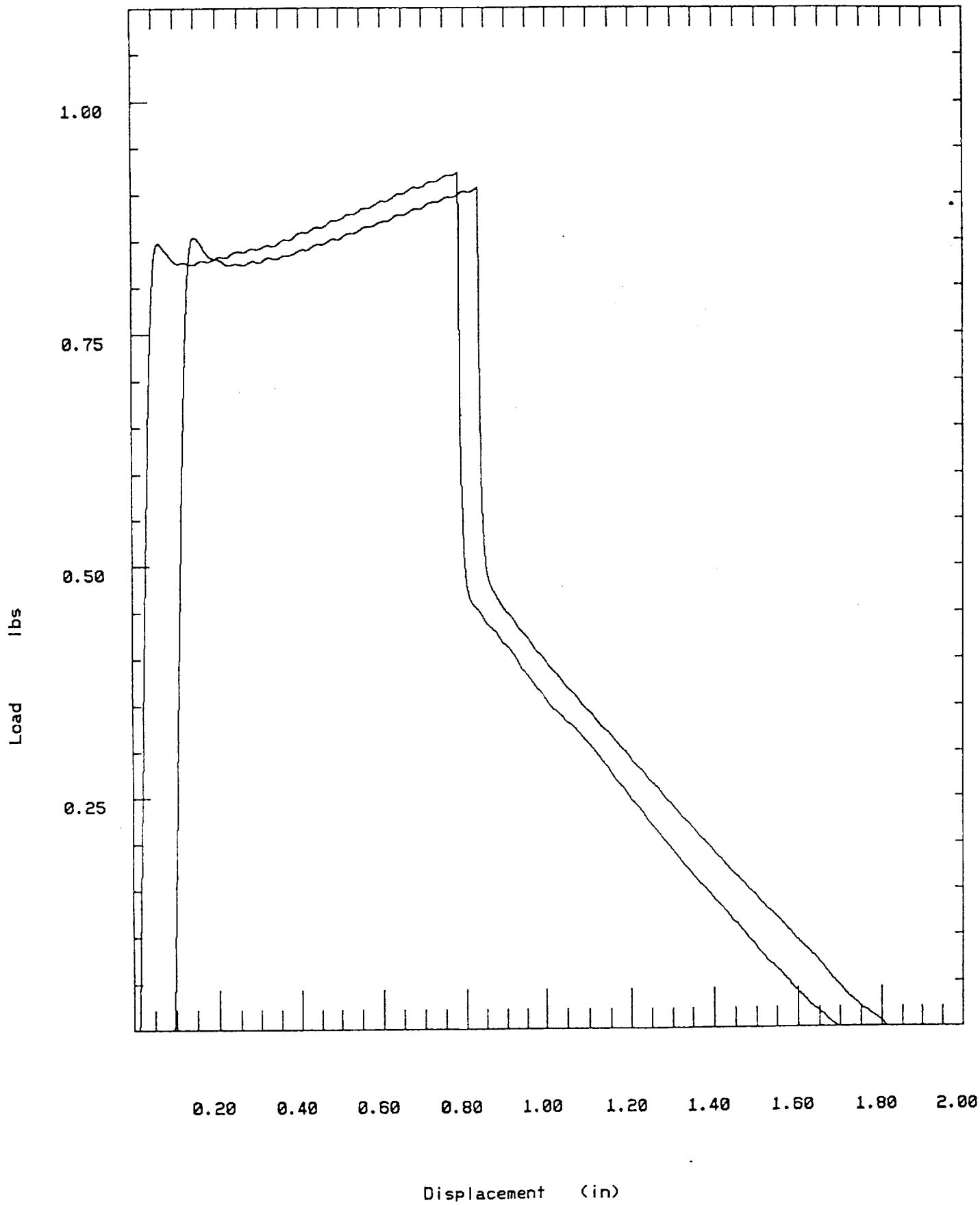
| Specimen<br>Number     | Displcmnt<br>at<br>Maximum<br>(in) | Load<br>at<br>Maximum<br>(lbs) | Maximum<br>Displcmnt<br>(in) | Maximum<br>Strain<br>(in/in) |
|------------------------|------------------------------------|--------------------------------|------------------------------|------------------------------|
| 1                      | .7702                              | .9229                          | 2.570                        | .6424                        |
| 2                      | .7359                              | .9073                          | 5.313                        | 1.3280                       |
| Mean:                  | .7531                              | .9151                          | 3.941                        | .9853                        |
| Standard<br>Deviation: | .0242                              | .0110                          | 1.940                        | .4850                        |
| Mean -<br>2.00 * Sdv:  | .7046                              | .8930                          | .062                         | .0154                        |
| Mean +<br>2.00 * Sdv:  | .8015                              | .9372                          | 7.821                        | 1.9550                       |
| Minimum:               | .7359                              | .9073                          | 2.570                        | .6424                        |
| Maximum:               | .7702                              | .9229                          | 5.313                        | 1.3280                       |





PANDA4

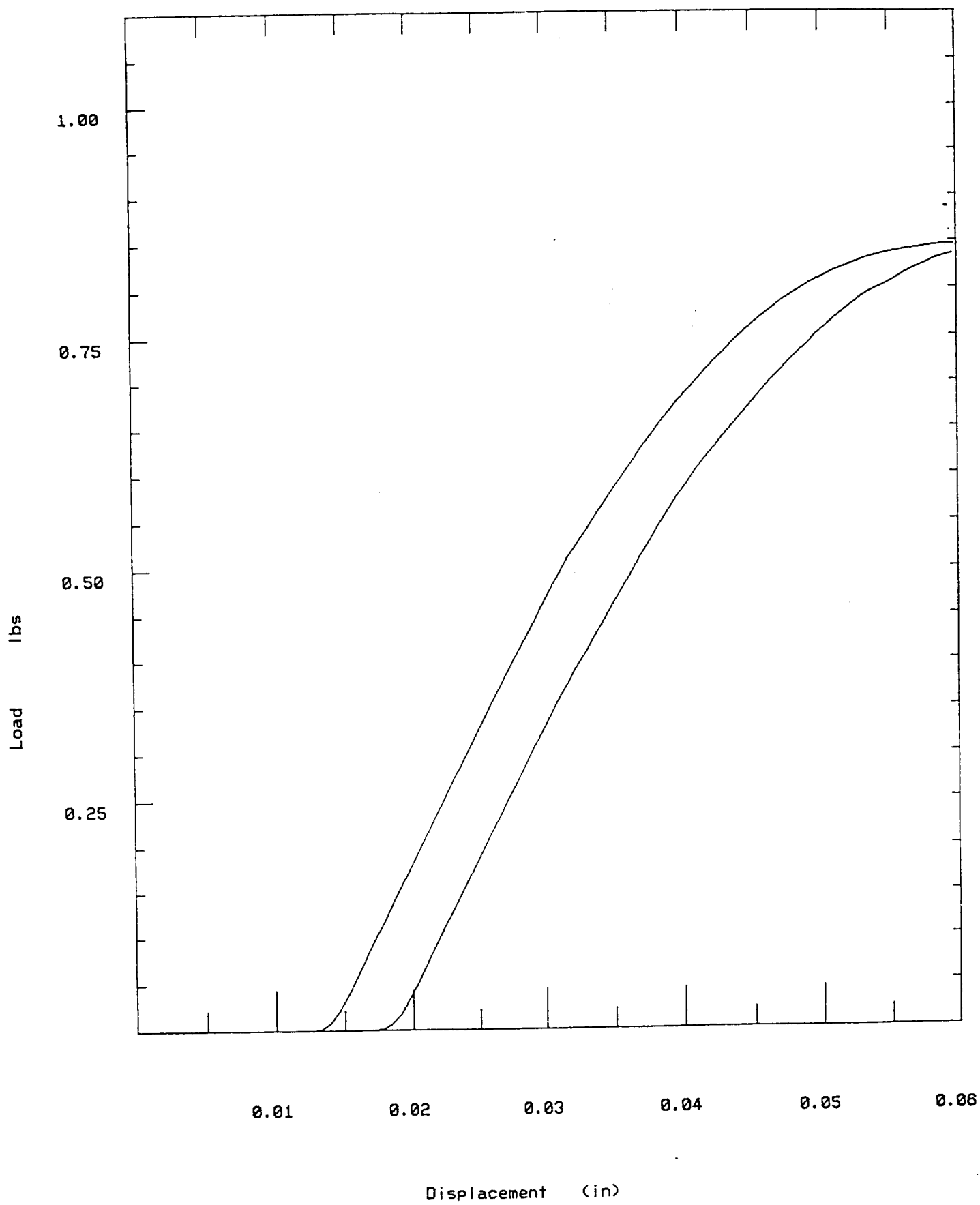
ALL





PANDA4

ALL





FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 7/20/92

Operator name: Al-amin Ally

Sample Identification: PANDAI

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000  
Crosshead Speed (in/min): .3500

Instron Corporation

Series IX Automated Materials Testing System 1.11

Test Date: 28 Jul 1992

Sample Type: ASTM

Humidity ( % ): 79

Temperature (deg. F): 73

TIME 2:20pm

TYPE OF FIBER Panda-type polarization fiber

Dimensions:

Spec. 1 Spec. 2 Spec. 3 Spec. 4 Spec. 5 Spec. 6

|                     |        |        |        |        |        |        |
|---------------------|--------|--------|--------|--------|--------|--------|
| Lin. Density (den)  | .12500 | .12500 | .12500 | .12500 | .12500 | .12500 |
| Spec gauge len (in) | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 |

Out of 6 specimens, 1 excluded.

Sample comments: Tests run at Xhead speed of .3500. Minor change in data presentation.

| Specimen<br>Number          | Displment<br>at<br>Maximum<br>(in) | Load<br>at<br>Maximum<br>(lbs) | Maximum<br>Displment<br>(in) | Maximum<br>Strain<br>(in/in) |
|-----------------------------|------------------------------------|--------------------------------|------------------------------|------------------------------|
| 1                           | .5140                              | 1.1490                         | 2.0280                       | .5071                        |
| 2                           | .0590                              | .9753                          | 1.2790                       | .3198                        |
| 3                           | .2732                              | 1.0360                         | 1.3050                       | .3263                        |
| 4                           | .5507                              | 1.0850                         | 1.7540                       | .4385                        |
| 5                           | .4659                              | .9938                          | 1.3120                       | .3280                        |
| *Excluded*                  | .0108                              | -.0008                         | .0120                        | .0030                        |
|                             |                                    |                                |                              |                              |
| Mean:                       | .3726                              | 1.0480                         | 1.5360                       | .3839                        |
|                             |                                    |                                |                              |                              |
| Standard<br>Deviation:      | .2053                              | .0706                          | .3389                        | .0847                        |
|                             |                                    |                                |                              |                              |
| Mean -<br>2.00 * Sdv: ***** | .9066                              | .8580                          | .2145                        |                              |
|                             |                                    |                                |                              |                              |
| Mean +<br>2.00 * Sdv: .7833 | 1.1890                             | 2.2140                         | .5534                        |                              |
|                             |                                    |                                |                              |                              |
| Minimum:                    | .0590                              | .9753                          | 1.2790                       | .3198                        |



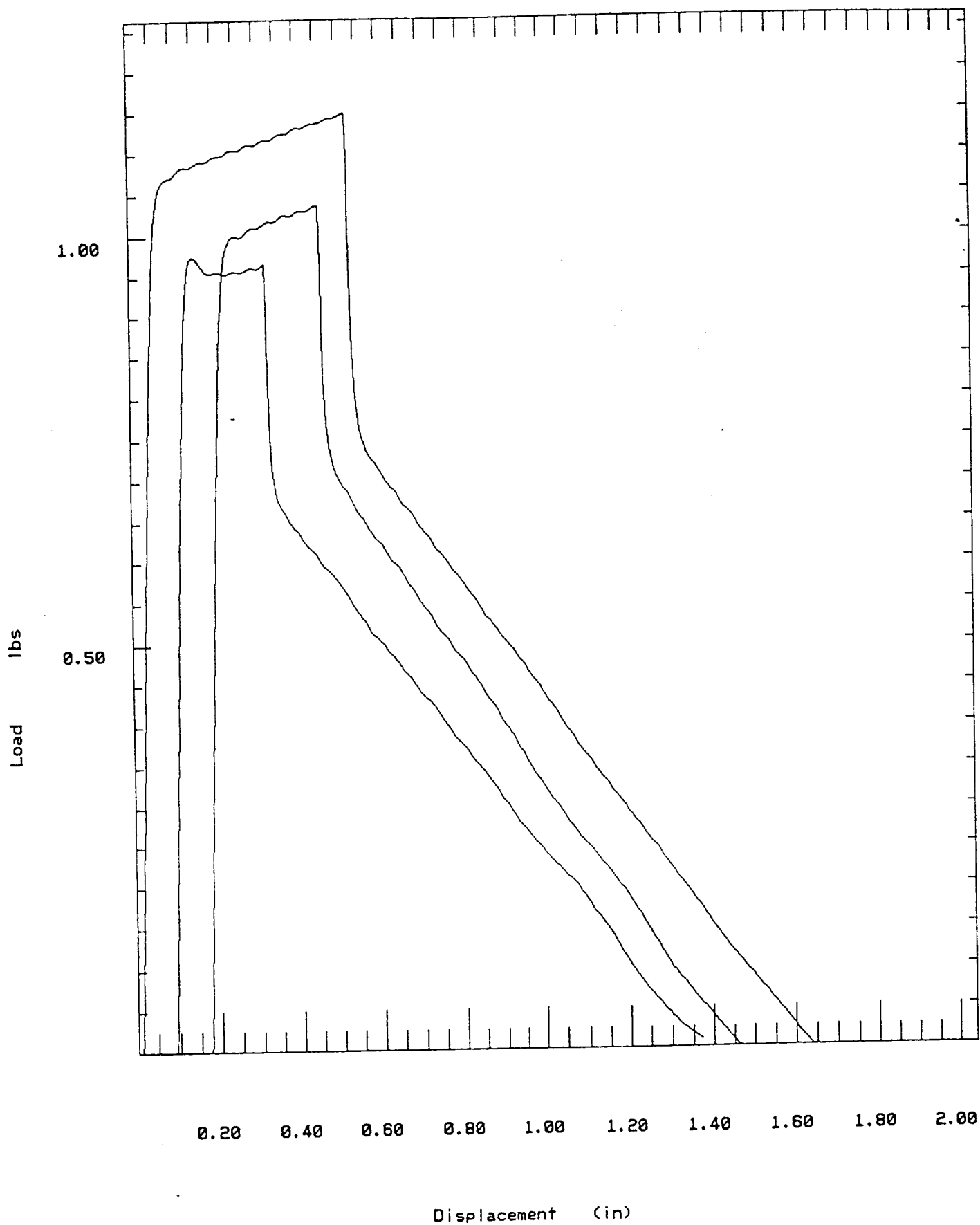
Maximum: .5507 1.1490 2.0280 .5071





PANDAI I

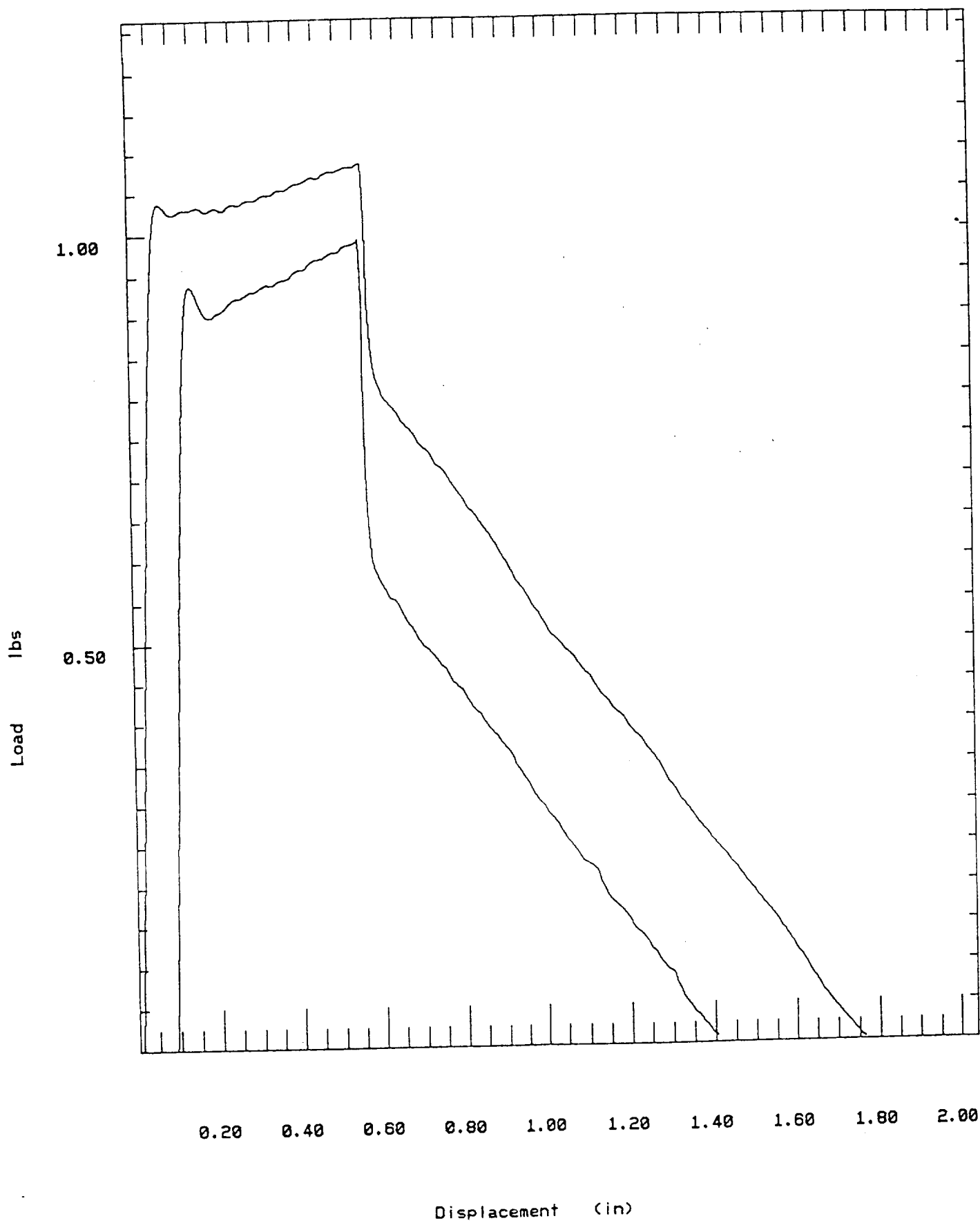
SPEC # 01 - 03





PANDAI I

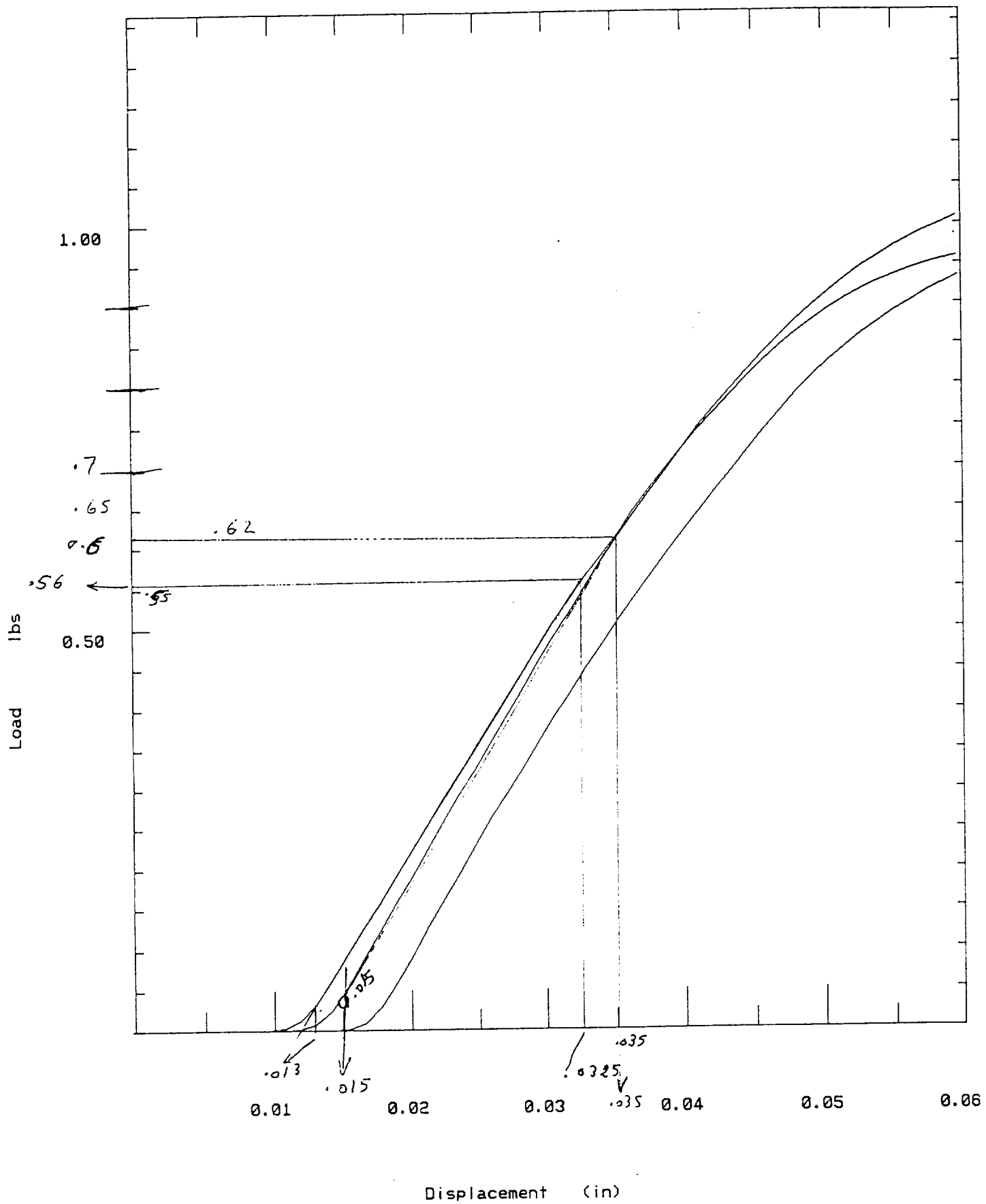
SPEC # 04 - 06



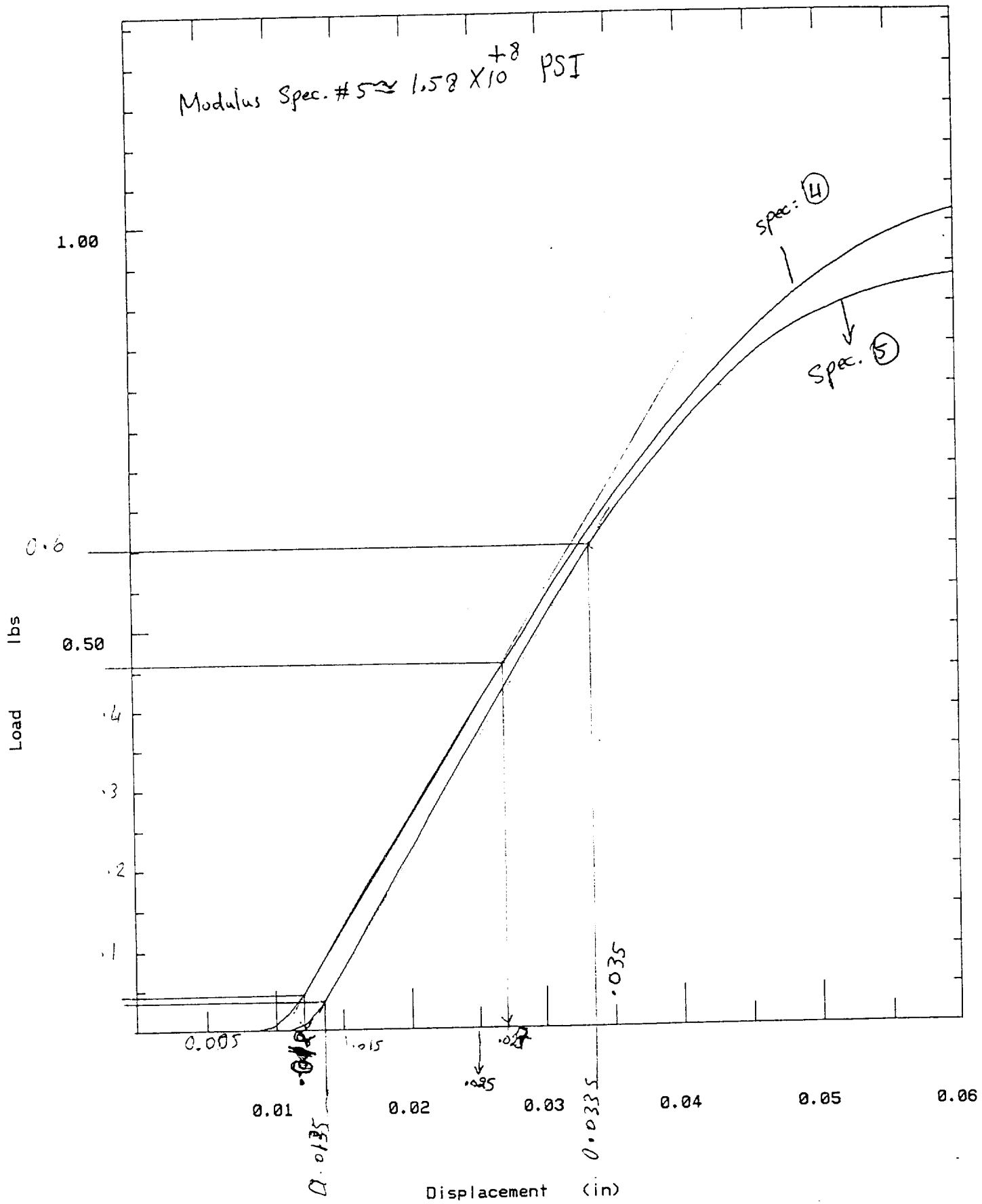


PANDAI

SPEC # 01 - 03











FIBER OPTICS  
CLARK ATLANTA UNIVERSITY  
JPL-REU RESEARCH

MECHANICAL PROPERTIES OF PANDA-TYPE  
POLARIZATION MAINTAINING  
OPTICAL FIBER.

Test type: FIBER 7/20/92

Operator name: AL-AMIN T. ALLY

Sample Identification: PANDA1

Interface Type: 4500 Series

Machine Parameters of test:

Sample Rate (pts/sec): 5.000

Crosshead Speed (in/min): .2000

Instron Corporation  
Series IX Automated Materials Testing System 1.11  
Test Date: 28 Jul 1992

Sample Type: ASTM

Humidity (%): 82  
Temperature (deg. F): 71

TIME: 11:52 am  
TYPE OF FIBER: PANDA-TYPE POLARIZATION OPTICAL FIBER

Dimensions: Spec. 1 Spec. 2 Spec. 3 Spec. 4 Spec. 5 Spec. 6 Spec. 7 Spec. 8

|                     |        |        |        |        |        |        |        |        |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Lin. Density (den)  | .12500 | .12500 | .12500 | .12500 | .12500 | .12500 | .12500 | .12500 |
| Spec gauge len (in) | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 |

Out of 10 specimens, 0 excluded.

Sample comments: The specimens behaved typically. Test run at Xhead speed of .2000

| Specimen<br>Number | Displcmnt<br>at<br>Maximum<br>(in) | Load<br>at<br>Maximum<br>(lbs) | Maximum<br>Displcmnt<br>(in) | Maximum<br>Strain<br>(in/in) |
|--------------------|------------------------------------|--------------------------------|------------------------------|------------------------------|
| 1                  | .0479                              | .8577                          | 1.524                        | .3811                        |
| 2                  | .3690                              | .9944                          | 1.787                        | .4468                        |
| 3                  | .7397                              | .9212                          | 1.914                        | .4786                        |
| 4                  | .3910                              | .9931                          | 1.221                        | .3052                        |
| 5                  | .6936                              | 1.0420                         | 1.785                        | .4462                        |
| 6                  | .4717                              | .9291                          | 1.773                        | .4434                        |
| 7                  | .5429                              | 1.0280                         | 1.651                        | .4127                        |
| 8                  | .5303                              | .9871                          | 1.515                        | .3788                        |
| 9                  | .5096                              | .9972                          | 1.539                        | .3848                        |
| 10                 | .4291                              | .9853                          | 1.675                        | .4187                        |

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| Mean: | .4725 | .9735 | 1.639 | .4096 |
|-------|-------|-------|-------|-------|

|                        |       |       |      |       |
|------------------------|-------|-------|------|-------|
| Standard<br>Deviation: | .1913 | .0553 | .198 | .0494 |
|------------------------|-------|-------|------|-------|

|                       |       |       |       |       |
|-----------------------|-------|-------|-------|-------|
| Mean -<br>2.00 * Sdv: | .0898 | .8630 | 1.243 | .3108 |
|-----------------------|-------|-------|-------|-------|

|                       |       |        |       |       |
|-----------------------|-------|--------|-------|-------|
| Mean +<br>2.00 * Sdv: | .8552 | 1.0840 | 2.034 | .5085 |
|-----------------------|-------|--------|-------|-------|

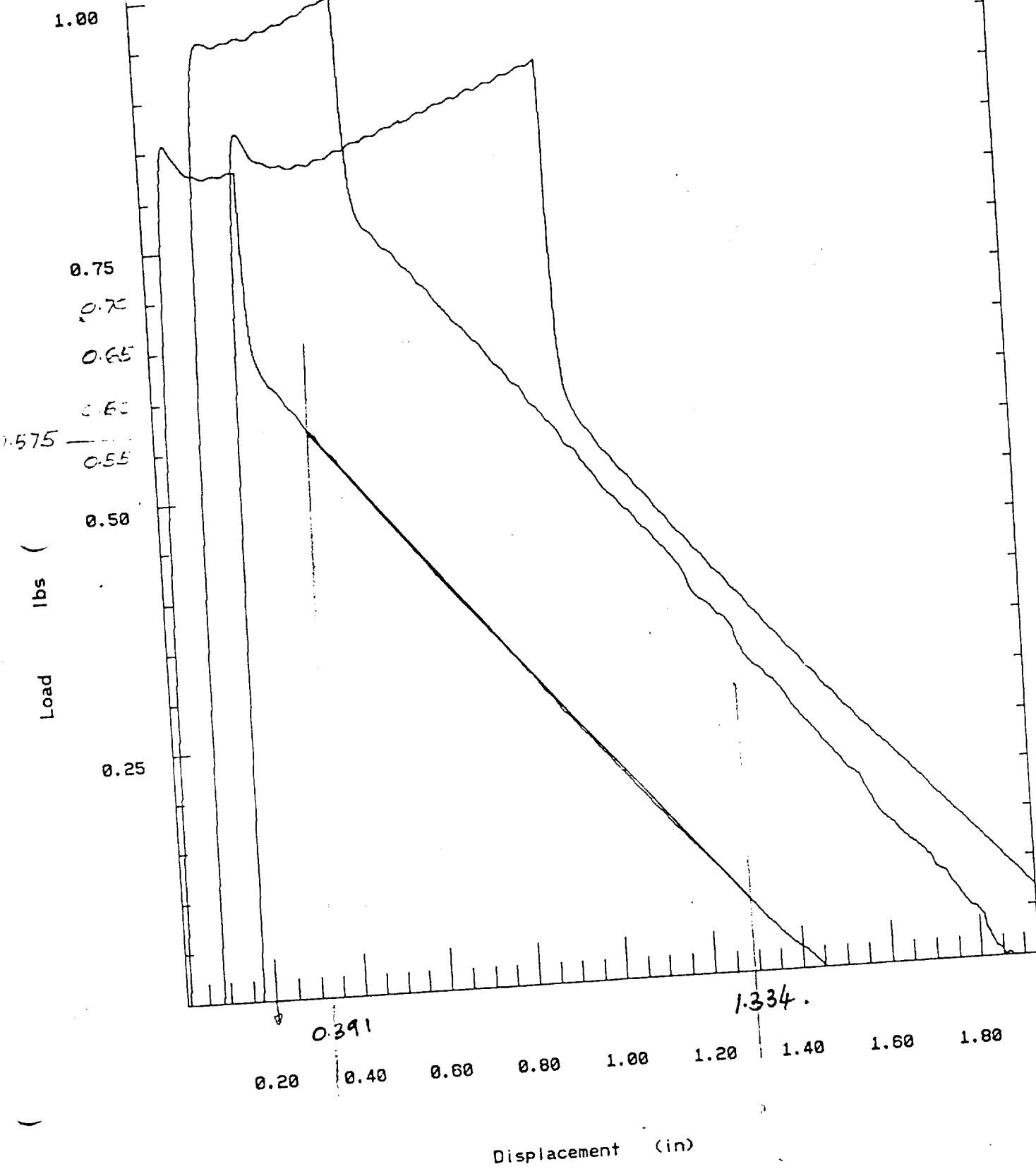


|          |       |        |       |       |
|----------|-------|--------|-------|-------|
| Minimum: | .0479 | .8577  | 1.221 | .3052 |
| Maximum: | .7397 | 1.0420 | 1.914 | .4786 |



PANDA1

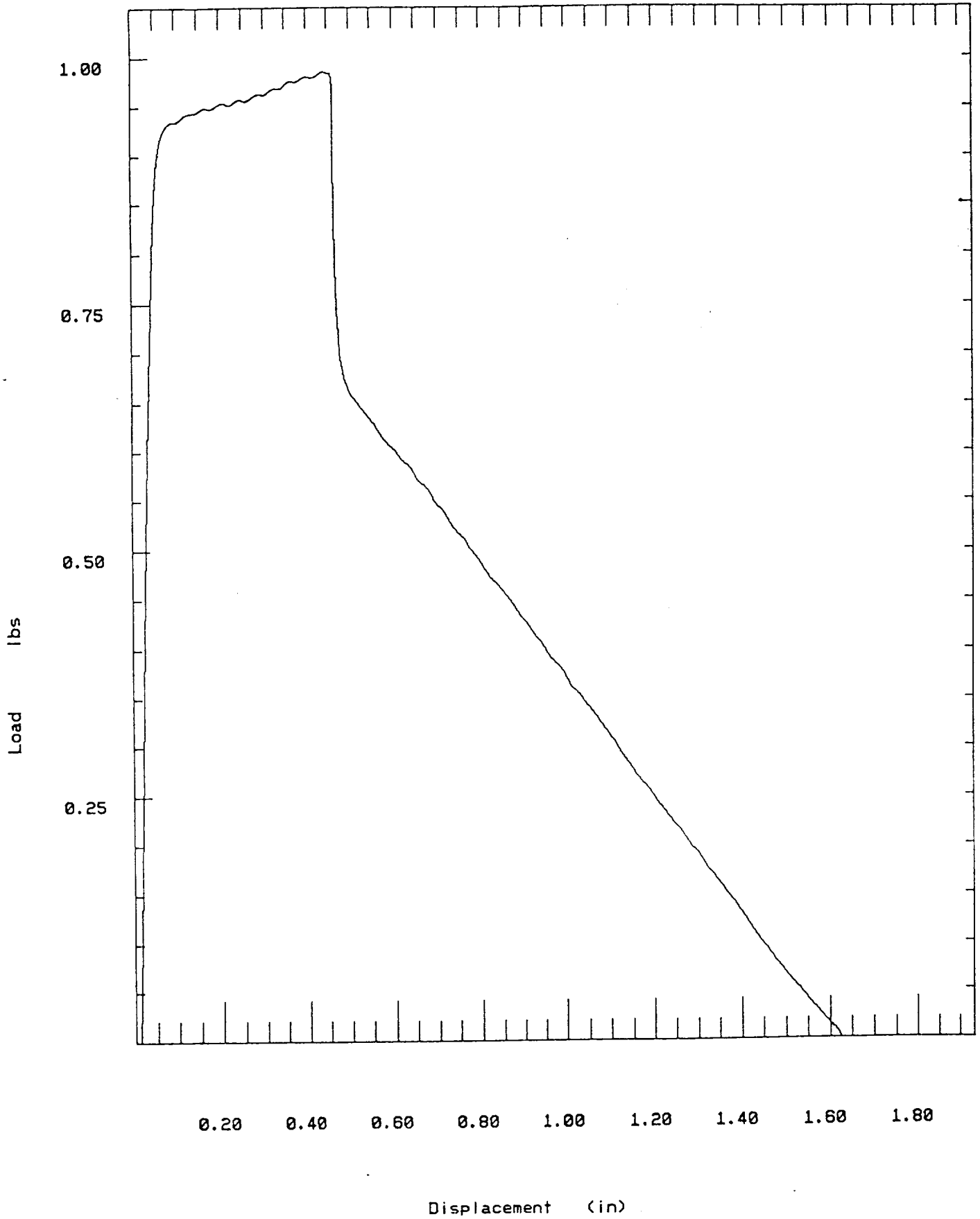
SPEC # 01 - 03





PANDA1

SPEC # 10

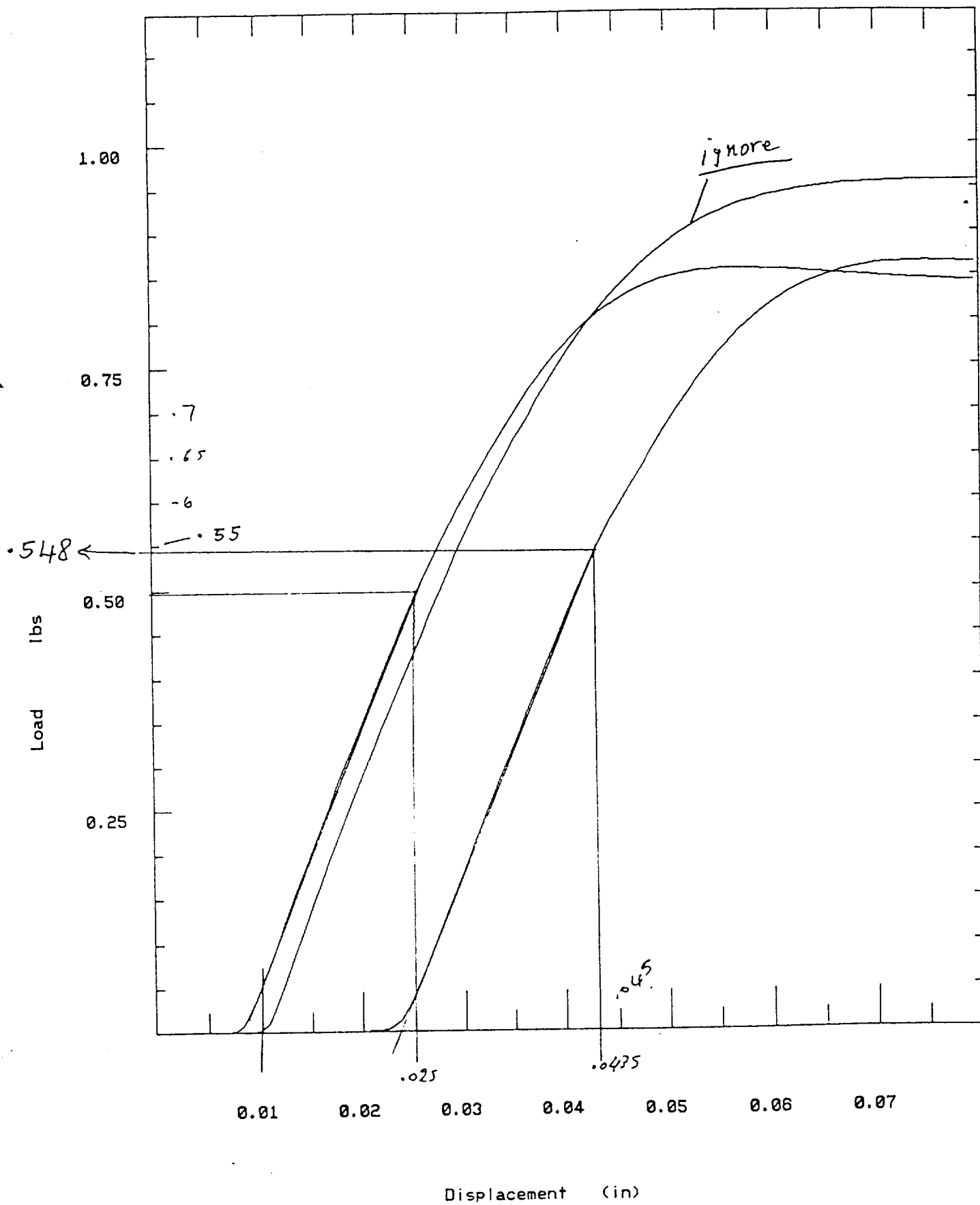




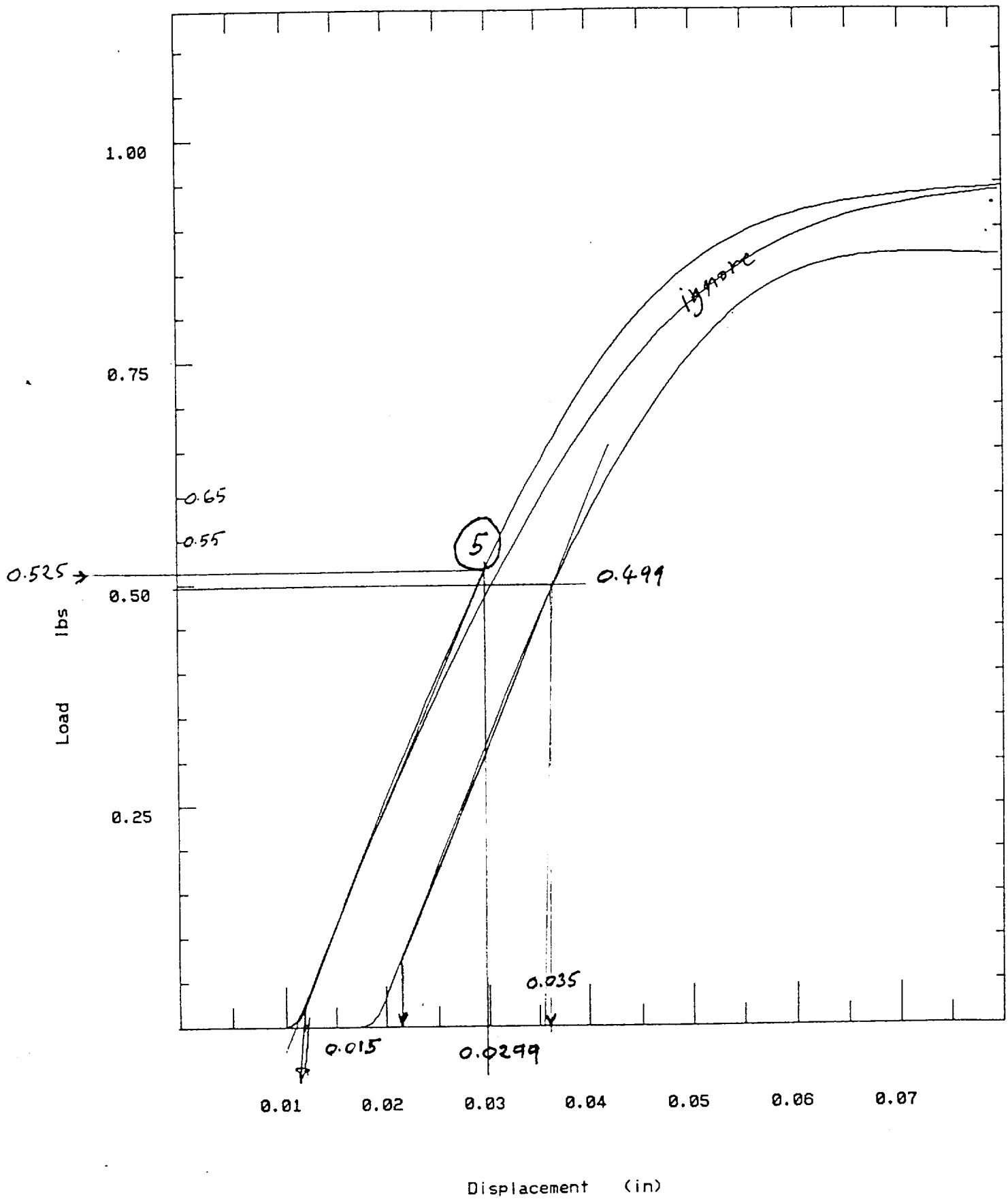


PANDA1

SPEC # 01 - 03



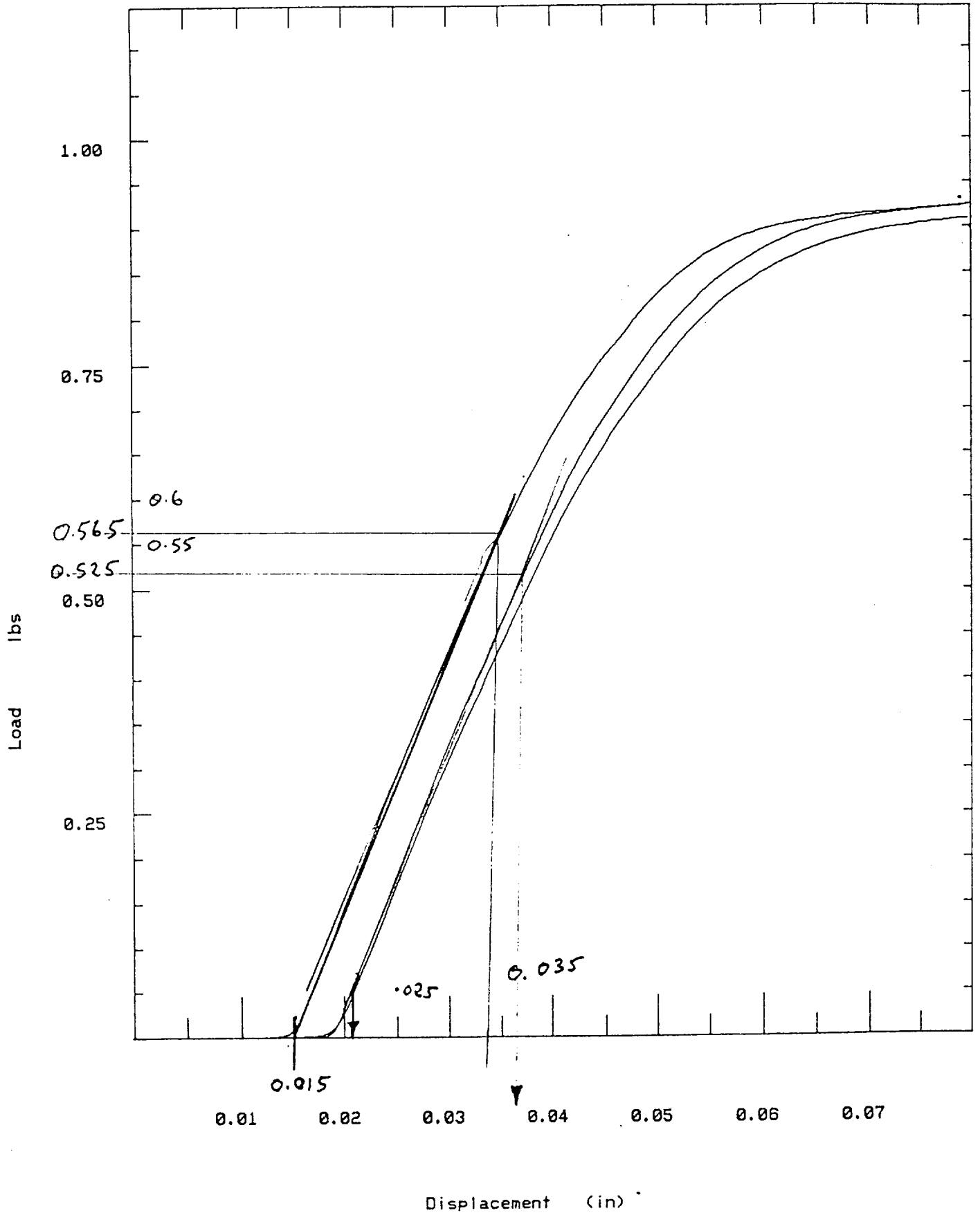






PANDA1

SPEC # 07 - 09





# **APPENDIX 4**

## **Abstract of Funded and Pending HiPPAC Related Proposals**

ORIGINAL PAGE  
COLOR ~~PHOTOGRAPH~~  
PAGE.





## ENHANCING CLARK ATLANTA UNIVERSITY PARTICIPATION IN DEFENSE RESEARCH

### ABSTRACT

Clark Atlanta University (CAU) submits this proposal in response to the Army Research Office (ARO) "Broad Agency Announcement; Enhancing Participation of Historically Black Colleges and Universities in Defense Research." Award of a grant by the ARO will provide CAU the opportunity to further develop and enhance the quality of its programs in science and engineering R&D and human resources development to meet the needs of the Defense Services, other federal agencies, and industry. Specifically, it will strengthen CAU's R&D and education programs in environmental sciences and engineering; structural dynamics, control and propulsion; computer-aided software engineering (CASE); and development of a generalized intelligent system for tutoring. Integral to the development of research and education programs is the concomitant development of infrastructure. Grant funds will also be utilized for facilities upgrades, instrumentation, equipment and technical support systems.

Projects in environmental policy and research will encompass analysis and formulation of policy options for effective environmental management for the Army. Environmental R&D will be conducted on topics such as thermodynamic modeling of chemical speciation; chemically sensitive ion-selective field effect transistors for *in situ* detection of toxic metals; and enhanced biodegradative remediation of hydrocarbon contaminated aquifers. In the aerospace sciences, research will be conducted on front frame failure in aircraft engines and advanced composites and structures.

Research in computer-aided software engineering (CASE) will be in areas such as design of an automated re-use system and object-oriented database environment on repository systems. Evaluation of commercially available CASE tools will also be conducted. CAU also proposes to design, develop, validate and apply artificially intelligent tutoring systems that will build on the experience of its faculty and staff in the design and development of instructional support systems for undergraduate pre-engineering courses in physical sciences and mathematics, as well as psychology and other areas.

Competitiveness among institutions and among countries is a function of both talent and infrastructure. Addressing the infrastructure needs of CAU in facilities and major scientific equipment will provide the opportunity for it to become more competitive within the mainstream of research and development in this country and around the world. The enactment of PL 100 570, *The Academic Research Facilities Modernization Act of 1988*, evidenced Congressional concern about the capacity of the nation's universities to conduct high quality research and education programs and to maintain the nation's competitive position at the forefront of modern science, engineering, and technology. A continued deterioration and lack of support for maintenance and development of the nation's technical infrastructure would result in the decline of the nation's future security, health and well-being and ability to compete in the



global marketplace. Accordingly, CAU proposes to address its infrastructure needs in facilities renovation and upgrades and major scientific equipment.

Considerable effort will be devoted to human resources development for the nation's science and technology enterprise. CAU will implement special programs to recruit, nurture, and train talented students, especially minorities, to obtain bachelor of science and master's degrees in science and engineering. The goal and objectives of these programs are to prepare these students to matriculate in and graduate from some of the best doctoral programs in this country.

The project will involve directly more than twenty-four current science and engineering faculty members each of whom will devote at least two person-months per year effort to research in which students will be active participants. Six additional full-time faculty will be recruited.

## **LABORATORY FOR ADVANCED AEROSPACE STRUCTURES**

### **ABSTRACT**

CAU is establishing and developing a strong research and educational program in aerospace related areas, the main goals of which are to prepare minority scientists and engineers for careers in the aerospace industry and academia. CAU has developed a Laboratory for Advanced Aerospace Structures (LAAS) that will have facilities and instrumentation necessary for experimental and computational research on advanced structural systems including composites and actively controlled structures. The LAAS laboratory conducts research on solid mechanics, fluid mechanics, propulsion, and composite materials. Through the LAAS laboratory and HiPPAC Center CAU is also developing strengths in the processing of polymers, ceramics, metals, and composite materials. The increased demand on materials for high performance in aerospace and military applications has focused attention on high performance polymers, ceramics, and metals for high temperature applications. There are ongoing research efforts at CAU in the areas of structural dynamics and control and propulsion which are funded by the Propulsion Directorate of the Air Force Wright Laboratories under contract No. F33615-90-C-2082.



# **Thermal Analysis System for Characterization and Evaluation of High Performance Polymers**

P.I.:

E. Mintz

## **Abstract**

Clark Atlanta University (CAU) has established a High Performance Polymers And Ceramics (HiPPAC) Research Center. The center consolidates and expands existing polymer and ceramic research capabilities through the development of interdepartmental and interinstitutional research and education clusters. To conduct basic and applied research in high performance polymers and ceramics in the Center, major equipment and instrumentation are required. In this proposal we request funds to acquire a thermal analysis system to support research projects conducted in the HiPPAC Center. This instrumentation will provide the HiPPAC Center investigators with the ability to examine the conversion of preceramic materials to ceramic materials, and the characterization of ceramic materials, in addition to the ability to characterize high performance polymers. The growth in research and education programs in the materials area at CAU, and in particular expansion into the preceramic and ceramic area, necessitates the acquisition of a thermal analysis system that includes a high temperature TG/DTA and DSC and TMA with programmable temperature control for below ambient conditions and higher operating temperatures and is capable of high throughput and state of the art diagnostic capabilities. The research projects that the thermal analysis system will support are part of CAU's strong commitment to enhance its overall development of research capabilities, strengthening minority faculty and student experiences, establishing interinstitutional research alliances with other HBCUs and major research universities, and strengthening its undergraduate and graduate science degree programs.



# Acquisition of an FT-Raman Instrument for Application in Surface Science and Catalysis

P.I.: M. Mitchell

Co-P.I.(s): Y. Mariam, E. Mintz

## RESEARCH SUMMARY

### THE INSTRUMENT

This proposal requests funds for the purchase of a Fourier transform Raman (FT-Raman) spectrometer. The FT-Raman system which we have requested is a Nicolet Model 910 FT-Raman instrument and is commercially available as a stand-alone unit from Nicolet Corporation. This instrument will be utilized to study and characterize a wide range of solid and supported catalysts, sorbents, and solid state materials. No Raman capability exists presently at Clark Atlanta University, and the requested instrument would complement many of our investigations which now rely solely on infrared data. Investigations utilizing the new capability will focus on developing a fundamental understanding of the structure, reactivity, function, and deactivation modes of heterogeneous catalysts and the structure and evolution of catalyst precursors *in situ*.

### DESCRIPTION OF THE ANTICIPATED IMPACT

We are developing a broad-based capability for the study of adsorption, decomposition, and reaction on surfaces, using vibrational spectroscopy as the cornerstone technique for the development of this capability. We have chosen vibrational spectroscopy because of its sensitivity and selectivity, and because a large database exists for the vibrational spectroscopy of materials adsorbed on solid supports. Vibrational spectroscopy has been used for more than three decades as a key technique for the observation of surface reactions, and to provide vital information regarding surface-catalyzed reaction mechanisms. Vibrational spectroscopy has been shown to be a powerful *in situ* technique. We currently have five funded projects which use infrared spectroscopy, specifically diffuse reflectance infrared Fourier transform spectroscopy, to probe surface adsorption/reaction chemistry on metal oxides, metal oxide supported and zeolite supported catalysts, and ceramics. Our Fourier transform infrared spectrometer is optimized for these studies and we are currently obtaining excellent results with this system. However, many of our identifications based on infrared results are ambiguous because of our inability to investigate vibrational frequencies in regions which overlap the substrate metal oxide absorptions. In particular, the oxidation of metal-containing organic precursors to form supported metal oxides can only be followed via decomposition of the organic precursor, with little information available regarding the ultimate form of the surface metal ion. Raman spectroscopy has been shown to be a powerful probe of the form of metal oxides supported on metal oxides. FT-Raman spectroscopy using near-infrared Nd-YAG lasers has the potential to eliminate interfering fluorescence and substantially improve the ability to observe Raman scattering from the surface oxides, compared to standard ultraviolet/visible laser Raman. This can be a crucial consideration, given the fact that even 10 ppm of a fluorescent impurity can swamp a Raman signal.





## INITIAL EXPERIMENTS

Three different research groups at Clark Atlanta University, all involved in one way or another with catalysis and surface chemistry, with eight current/pending projects five of which are funded by DOE, would directly benefit from the acquisition of such an instrument, and those research areas are discussed in the body of the proposal.

The initial experiments will involve the study of supported catalyst precursors on metal oxide and zeolite surfaces, the evolution of these precursors to form surface oxides and other active forms, and ultimately the adsorption and reaction of gas-phase species on the catalyst surface. The use of the FT-Raman will be to investigate those regions of the vibrational spectrum which are masked in the infrared by the substrate absorptions, and to help elucidate the nature of a catalyst prepared from a particular precursor and help identify the species participating in a surface-catalyzed reaction.

## STUDENT IMPACT

Over the past two years six students' projects could have been impacted by the instrumentation requested. Currently, two graduate students and two undergraduate students are working in Dr. Mitchell's laboratory on DOE-funded projects which would be significantly impacted by the proposed instrument. One graduate student working in Dr. Mariam's laboratory on Si-C-O-N-M(etal) ceramic materials would benefit from the requested instrument. Two graduate students in Dr. Mintz's laboratory working on the evolution of metal-oxide supported organometallic complexes will be significantly impacted by the proposed acquisition. Based upon the current funding of the three groups expected to be the principal users of this instrumentation, we anticipate a minimum of five students per year will be greatly affected by the proposed instrument. We anticipate that once this capability is in place, students working in other research groups will also benefit from the availability of this instrument.



# High-Field Nuclear Magnetic Resonance Spectrometer for Characterization and Evaluation of High Performance Polymers and Ceramic Precursors

P.I.(s): Ishrat Khan

Co-P.I.(s): L. Torres, E. Mintz, L. Moeti, Y. Mariam

## Research Summary

Clark Atlanta University (CAU) established a High Performance Polymers And Ceramics (HiPPAC) Research Center in November 1991. The center consolidates and expands existing polymer and ceramic research capabilities through the development of interdepartmental and interinstitutional research and education clusters. To conduct basic and applied research in high performance polymers and ceramics in the Center, major equipment and instrumentation are required. The research projects that the 400 MHz NMR will support are part of CAU's strong commitment to enhance its overall development of research capabilities in the material sciences, strengthening minority faculty and student experiences, establishing interinstitutional research alliances with other HBCUs and major research universities, and strengthening its undergraduate and graduate science degree programs.

The 400 MHz Nuclear Magnetic Resonance spectrometer for which funds are requested in this proposal, and which will be used to support research projects on high performance polymers and ceramics in the HiPPAC Center at Clark Atlanta University is a JEOL JNM-CPF/EX400 instrument. This instrument would replace an aging Bruker WL-250 instrument purchased in 1979, and which is at present the only high field NMR instrument available in at CAU and in the AUC Center for solution work.

The features of this state of the art Fourier Transform NMR spectrometer include: (1) a superconducting solenoid operating at 9.4T providing proton observation at 400 MHz and carbon at 100 MHz ; (2) Probes: 5mm proton/multifrequency variable temperature NMR probe and a GBBS broadband system; and (3) a GVT3 Variable temperature system covering the range from -150 to +180 °C. The instrument is controlled by and the data processed on a DEC 11/53 system control processor with a DEC RSX-11M operating system. It also includes comprehensive FT-NMR acquisition/processing software (MultiPlexus).

We propose to carry out studies on nuclei such as  $^2\text{H}$ ,  $^{29}\text{Si}$ ,  $^{27}\text{Al}$ ,  $^{23}\text{Na}$  and  $^7\text{Li}$  in addition to  $^1\text{H}$  and  $^{13}\text{C}$ . For the less sensitive nuclides we require state of the art capabilities in



terms of multi-pulse programming, and to study temperature-dependent phenomena a computer-controlled variable temperature system is needed.

The NMR spectrometer, in addition to routine characterization of new materials, will be used to carry out specialized experiments to study the dynamic, kinetics and phase behavior of materials. Initial experiments will include the  $^7\text{Li}$  and  $^{23}\text{Na}$  NMR studies of poly(ethyleneoxide)/poly(2- or 4-vinylpyridine)/ $\text{LiClO}_4$  or  $\text{NaClO}_4$  amorphous blends (these studies will be carried out on bulk samples above the glass transition temperatures), to determine the nature of ion-pairing (multiplets, clusters, free ions) and to elucidate information about the ionic mobilities and mechanism by which the polymers are compatibilized. Another example is the determination of the kinetic parameters of the gel formation through acid catalyzed coagulation/gelation in processing by  $^{29}\text{Si}$  NMR. The mechanism of the process will be evaluated by following the  $Q_n$  ( $n=1$  to 4) structural units by NMR. The NMR spectrometer will be utilized to characterize polymers in the effort to prepare a new class of steric-stereoregular (i.e. helical) polymers. In order to achieve the goal of developing synthetic methods to prepare steric-stereoregular polymers, the detailed tacticity information must be obtained. As the steric-stereoregular polymers must be highly isotactic (>90%), pentad sequence (mmmm, mmrr, mrrr ...) information will be obtained. The different pentad sequences will be assigned by comparing with the NMR spectra of pure stereoisomers of oligomers (trimers, tetramers, pentamers ...) and using polymer sequence statistics.

Of the sixteen (13) HiPPAC investigators at CAU, eighth (8) of them have research projects that would utilize the high field NMR. These faculty have 12 graduate students and in excess of ten undergraduate students working with them whose research would benefit from the requested instrumentation. As the HiPPAC Center and the Department of Chemistry grows with the opening of the Research Center for Science and Technology we expect this number of faculty and students to increase dramatically over the next three years.



# Clark Atlanta University Research Experiences for Undergraduates in Chemistry Program

P.I.: C. Parker

Co-P.I.(s)

L. Torres, M. Mitchell, E. Mintz, L. Moeti, H. McBay

## ABSTRACT

This proposal outlines the development of a Research Experiences Program for Undergraduates in Materials Science to be housed at Clark Atlanta University. Clark Atlanta University is in a unique position to address the lack of minority representation in the science professions and chemistry in particular, both geographically and philosophically. Located in Atlanta, Georgia, in the heart of the southeastern United States, Clark Atlanta University has dedicated itself to improving science and technology literacy among minority populations. One of its fundamental missions is to increase the participation of minority students in all segments of the science and engineering pipeline.

This program will allow students to participate in active research programs in materials science in a stimulating research environment during the summers between their sophomore and junior years and between their junior and senior years of college. This program will also provide encouragement and support to students wishing to pursue graduate study in chemistry. The program will introduce student participants to state-of-the-art research activities at Clark Atlanta University. Clark Atlanta University is in a unique position of being one of only two Historically Black Colleges and Universities (HBCUs) to offer the Ph.D. degree in both Chemistry and Biology. As a predominantly minority institution with a graduate program in Chemistry, Clark Atlanta University can offer gifted minority students something which few other institutions can offer, participation in a world-class research environment in an institution with a significant number of minority faculty and graduate students to serve as role models (more than of 50 % of the faculty and graduate students are minorities). This distinct character of Clark Atlanta University is one which will help to maximize the probability that promising undergraduate students will make the transition to graduate school.

The goal of the proposed program is to seek and attract bright undergraduate students, particularly minority students. It will actively involve these students in research programs that will develop and encourage them to pursue science careers, particularly chemistry, ultimately leading to a Masters or Ph.D. degree.





# Synthesis and Processing of High Performance Polymers and Polymer-Based Carbon and Ceramic Materials

PI: Agaram Abhiraman, (Ga. Tech.)  
Co-P.I. (s) P. Desai (Ga. Tech.), M. Polk (Ga. Tech.), L. Tolbert  
(Ga. Tech.), S. Warner (Ga. Tech.), I. Khan, L. Moeti,  
E. Mintz, Y. Mariam, M. Mitchell

## SUMMARY

This proposal for twelve (12) NSF graduate research traineeships emphasizes strengthening the nation's human resources in the field of high performance polymers and polymer-based carbon and ceramic structures. The program will be guided jointly by a group of faculty from the Polymer Education and Research Center (PERC) at Georgia Tech and the Clark-Atlanta University-Georgia Tech High Performance Polymers and Ceramics Center (HiPPAC). GT has an enviable history of attracting outstanding students to its graduate programs in science and engineering, with a significant enrollment of women and minority students. The HiPPAC center has already helped initiate a significant cooperative research effort between GT and CAU in the field of advanced materials. CAU is a premier historically black university in the training of minority students at both the undergraduate and graduate levels.

The team of research guides from the two institutions brings together a complete range of expertise in the required fundamental and applied disciplines and an extensive history of interactions with industry. It will provide a fertile interdisciplinary environment for training Ph.D. students with synergistic integration of synthetic chemistry, primary structural analysis of materials, phase transitions, rheology, chemical and morphological evolution from polymers to ceramic materials, process dynamics and physical properties of materials. The objective is to couple graduate education in generic science and multidisciplinary engineering disciplines with research on the formation, structure and properties of high performance materials. The research traineeship program will address the following

1. Novel Electroactive Polymers And Block Copolymers.
2. Towards Superlattice Polymeric Materials for Nanoelectronic Devices.
3. In-Situ Preparation and Characterization of PBO-Polyamide and Polyimide Molecular Composites.
4. Surface And Interfaces Of Polymers
5. Formation and Analysis of Precursor Polymer-based Ceramic Fibers and Composites



## Enhancing Research Collaboration Between CAU and CERWAT at Georgia Tech for Training Minority Students

P.I.:

L. Moeti

Co-P.I.(s)

E. Mintz, E. Armanios (Ga. Tech.)

### ABSTRACT

Clark Atlanta University (CAU) proposes to develop a Laboratory for Advanced Aerospace Structures (LAAS) that will have facilities and instrumentation necessary for experimental and computational research on advanced structural systems including composites and actively controlled structures. The LAAS laboratory will conduct research on solid mechanics, fluid mechanics, propulsion, and composite materials. CAU has also established a High Performance Polymers and Ceramics (HiPPAC) Center, which was recently selected for major funding by NASA as a center of excellence. The LAAS laboratory and HiPPAC Center are designed to consolidate and expand existing research capabilities at CAU through the development of interdepartmental and interinstitutional research clusters. This proposal will utilize the facilities and expertise of the Georgia Institute of Technology's Center of Excellence in Rotary Wing Aircraft Technology (CERWAT) within the framework of the Georgia NASA Space Grant Consortium to expose CAU undergraduate students to a research environment at a major research university to encourage their matriculation to graduate school and develop collaborative research programs between faculty members at CAU and Georgia Tech. Faculty members from CAU who are members of the LAAS laboratory and HiPPAC Center will work with their counterparts from Georgia Tech's CERWAT and act as mentors to students from their university. This type of research experience will familiarize students with graduate programs and provide a smooth transition from undergraduate to graduate school. In addition, it will build collaborative working relationships between CAU and Georgia Tech faculty that will benefit both institutions.



## Clark Atlanta University Research Experiences for Undergraduates in Chemistry Program

P.I. (s): Cass Parker

Co-P.I.(s): M. Mitchell, E. Mintz, HC. McBay, L. Moeti

The objective of the proposed CAUREU program is the development of a Research Experience for Undergraduates program to be housed at Clark Atlanta University which will enlist the participation of promising minority students, beginning the summer after their sophomore or junior year in college, in state of the art research projects at Clark Atlanta University.

This program will allow students to participate in active research programs in materials and environmental science in a stimulating research environment during the summers between their sophomore and junior years and between their junior and senior years of college. This program will also provide encouragement and support to students wishing to pursue graduate study in chemistry. The program will introduce student participants to state-of-the-art research activities at Clark Atlanta University. Clark Atlanta University is in an unique position of being one of only two Historically Black Colleges and Universities (HBCUs) to offer the Ph.D. degree in both Chemistry and Biology. As a predominantly minority institution with a graduate program in Chemistry, Clark Atlanta University can offer gifted minority students something which few other institutions can offer, participation in a world-class research environment in an institution with a significant number of minority faculty and graduate students to serve as role models (more than of 50 % of the faculty and graduate students are minorities). This distinct character of Clark Atlanta University is one which will help to maximize the probability that promising undergraduate students will make the transition to graduate school.

The goal of the proposed program is to seek and attract bright undergraduate students, particularly minority students. It will actively involve these students in research programs that will develop and encourage them to pursue science careers, particularly chemistry, ultimately leading to a Masters or Ph.D. degree.



**Jet Propulsion Laboratory Program for Research Integration and  
Support for Matriculation to the Doctorate at  
Clark Atlanta University.**

P.I.: M. Webb

Co-P.I.(s): E. Mintz, L. Moeti

**ABSTRACT**

Clark Atlanta University (CAU), in its response to the national concern of education of underrepresented minorities, has over the past five years established and conducted several new programs. These have been conducted under the auspices of two major initiatives: (1) The Atlanta Comprehensive Regional Center for Minorities (ACRCM), established in 1988 by CAU, industry, and the National Science Foundation; and (2) The CAU Office of Naval Research (ONR) Program for Research Integration and Support for Matriculation to the Doctorate (PRISM-D) initiated in 1989. Annual evaluations by the respective agencies, NSF and ONR, which provide the bulk of the funding for these two programs, have shown them to be very effective. We request funding by this proposal to expand their scope and replicate, in particular, the ONR PRISM-D program with a focus on science and engineering education at the undergraduate level to establish a Jet Propulsion Laboratory Program for Research Integration and Support for Matriculation to the Doctorate (JPL PRISM-D). This replication will be tied to the undergraduate dual degree in engineering program between the Atlanta University Center (AUC) and the Georgia Institute of Technology, and the CAU five years BS/MS honors program. The dual degree program is a unique program sponsored by the Georgia Institute of Technology College of Engineering and the AUC offering the challenge of earning two undergraduate degrees in five years. The first three years are spent at one of the AUC institutions where the students complete a B.S. in general science, physics, chemistry, mathematics, or computer science, and occasionally, biological sciences. The remaining two years are spent at Georgia Tech to earn a B.S. in engineering. CAU is also strongly committed to its five year BS/MS honors program and believes in its success for chemistry, physics, mathematics, and computer science students and would extend it to include JPL-PRISM-D students. The university will attempt to acquire additional funds to support JPL-PRISM-D non-engineering students for their fifth year to complete the BS/MS program and for engineering students to complete the dual degree program.





**A Planning Grant for Research on High Temperature Oxide and  
Non-Oxide Ceramic Fibers. (DMR-9252993)**

P.I.: L Moeti

**ABSTRACT**

The objective of the proposed research is the development of a fundamental understanding of the processing requirements necessary to fabricate oxide and non-oxide ceramic fibers which will retain excellent mechanical properties at high temperatures. These fibers would be used as reinforcements in composite materials for advanced structural applications such as high temperature engine components. At present, currently available fibers are of limited use at high temperatures due to several reasons, such as, the mechanical properties of the fiber are reduced at high temperatures (e.g., due to the presence of liquid phases) and the fiber and matrix react producing undesirable products degrading the mechanical properties of both the fiber and matrix. The proposed research will use sol-gel and polymer-pyrolysis processing methods to develop oxide (e.g., mullite and stabilized zirconia) and non-oxide (e.g., silicon carbide and silicon nitride) ceramic fibers, respectively. The emphasis in this research will be on developing a fundamental understanding of the physical and chemical structural evolutions occurring during the process of fiber fabrication starting from the precursor material through the final dense ceramic fiber. Such an understanding would lead to improvements and modifications in processing, resulting in ceramic fibers with improved high temperature mechanical and chemical properties.



## SUPERCONDUCTING MATERIALS PROCESSING

### ABSTRACT

A new approach for making high temperature superconducting materials will be examined. The Spin-On /Pyrolysis technique is receiving increasing attention because it does not require vacuum processing. The processing cost using such techniques would not be high compared to other methods which use expensive and complicated vacuum reactors. However to exploit this unique advantage, the Spin-On/ Pyrolysis technique must be optimized to improve product yields, processing time, and the maintenance of mechanical and other product performance attributes. This calls for complete understanding of the reaction mechanism involved and development of appropriate process parameters that could be used for manufacturing automation and product scale up.

This project will therefore examine key unit operation steps involved, develop appropriate process equipment using mathematical models as a guide to equipment design to optimize this technique using modern Chemical Engineering methods. Advanced instrumentation such as the Rutherford Backscattering spectroscopy, X-ray diffraction / Transmission electron microscopy and the 4-point Van der Pauw technique would be used to assess product characteristics/ quality as well as performance.



# Experimental Measurement of the Physical and Mechanical Properties of a Polarization-Maintaining Optical Fiber.

P.I.):

L. Moeti

Co-P.I.(s)

S. Moghazy, P. Desai (Ga. Tech.), A. Abhiraman  
(Ga. Tech.)

## ABSTRACT

Clark Atlanta University (CAU), a historically black university, is pleased to submit this statement of work to the Jet Propulsion Laboratory (JPL) for the experimental measurement of the physical and mechanical properties of a panda-type polarization-maintaining optical fiber. To conduct the experimental effort in the statement of work a team of investigators from CAU and the Georgia Institute of Technology have been assembled. These investigators have considerable experience in the synthesis, characterization, and testing of polymer, ceramic, and textile fibers. To conduct the experimental measurements in this statement of work it is requested that the polarization-maintaining optical fiber be supplied both with and without its cladding. In addition, a commercial single-mode optical fiber should be supplied via JPL to be used as a control for all mechanical and physical testing. A final report will be prepared describing all experimental tasks and detailing all the physical and mechanical properties measured during the duration of this effort. Both reduced and raw experimental data will be submitted. Recommendations for reliability prediction tools will be made as this effort progresses based on the physical and mechanical data.



# Protective Bore Coatings for Large Caliber Guns

P.I.: L. Moeti  
Co-P.I.(s): E. Mintz, M. Mitchell, O. Sowemimo,  
W. Lackey (GTRI), Starr, Freeman GTRI), E. K.  
Barefield (Ga. Tech.)

## 1.0 Summary

The objective of the proposed three year project is to develop protective ceramic coatings for the bore of large caliber guns using the chemical vapor deposition (CVD) process. In order for the coating to effectively and reliably reduce the rate of bore deterioration the coatings must meet a number of requirements including high wear resistance, thermal and mechanical shock resistance, low friction, thermal stability, excellent adherence to the substrate, and be unaffected by environmental exposure. Coating materials of interest include boron carbide ( $B_4C$ ) and codeposits of boron carbide and boron ( $B_4C + B$ ) and several single phase and dispersed phase composite materials from the Ti-B-Al-C-N system. Zirconium carbide and oxide are also of interest. In the case of the composite coatings the second phase provides increased fracture toughness and in some instances lubrication.

Chemical vapor deposition, by contrast with the physical vapor deposition methods, is not a line-of-sight coating process and as such is well suited for uniformly coating irregular surfaces such as the rifling in a gun barrel. The CVD process has been shown to be commercially practical for dozens of important ceramic coating applications including microelectronics, cutting tools, and oxidation-erosion protective coatings for high temperature carbon-carbon composite materials. Furnaces having dimensions of 4 meters have been routinely operated commercially. The coatings are dense and strong, and possess superior mechanical properties to ceramics fabricated by conventional processes. Experience in using monolithic ceramic liners for gun barrels has not been promising but the superior mechanical properties of CVD coatings offers promise where liners have failed. Further, by using modern control techniques it is possible to continuously alter the coating composition throughout its thickness. For example, a graded  $B_4C + B$  coating containing a high percentage of boron could be deposited adjacent to the metal barrel in order to promote adherence while the surface of the coating contacting the projectile could be rich in the wear resistant boron carbide phase.

The proposed project is multidisciplinary and consists of the following four Tasks:

- Task 1. Requirements and Coating Identification - This task will first involve identification, with assistance from the U.S. Army Armament Research, Development and Engineering Center (ARDEC) staff, of the critical guns that would benefit most from the development of ceramic bore coatings. This initial effort will be completed early in the project in order to permit a thorough, methodical identification of the functional requirements of a successful coating. A detailed assessment of potential coating materials including the processes and costs of synthesizing the required CVD reagents will be performed. This, coupled with early experimental results will permit down selection to one or two preferred coatings for further development.
- Task 2. Reagent Synthesis - In order to deposit the coatings at sufficiently low temperatures to prevent damage of the metal gun barrel substrate, organometallic reagents are required for the chemical vapor deposition process. While we and others have prepared some of the needed reagents an important aspect of this research is the preparation of a compatible set of metalorganic reagents for boron, titanium, and aluminum. Zirconium-bearing reagents will also be synthesized. An iterative approach is envisioned where a set of reagents will be prepared and characterized for properties and CVD behavior and then another set of reagents will be prepared.
- Task 3. Coating Deposition and Modeling - This effort involves the use of chemical vapor deposition to prepare ceramic coatings using the reagents synthesized in Task 2 as well as several commercially available reagents. Computerized thermodynamic calculations will be used to assist in selection of the preferred reagent type and CVD process





variables such as temperature, pressure, and reagent concentration. The mass transport and kinetics of the deposition process will be analyzed in order to assist process optimization, e.g., obtaining coatings having uniform composition and thickness over large areas. The experimental studies will make maximum use of statistically designed and analyzed experiments.

- Task 4. Characterization of Deposits - The ceramic coatings, which will be deposited on metal coupons of gun barrel materials, will be characterized for composition, phase assemblage, microstructure, density, porosity, adherence, hardness, residual stress, mechanical properties and coating thickness. These attributes will be measured using available analytical facilities. As necessary, use will be made of the microanalytical facilities of the High Temperature Materials Laboratory User Center at the Oak Ridge National Laboratory. Tribological properties will be extensively evaluated in a companion program also being proposed to ARDEC.

Details of the proposed schedule and milestones appear in Figure 1.

By utilizing staff from Clark Atlanta University and the Georgia Institute of Technology we believe we have assembled a team of experienced investigators possessing the required, specific expertise and facilities to successfully accomplish the proposed project. We have demonstrated expertise in the selection, synthesis, and use of organometallic reagents for chemical vapor deposition of ceramic coatings including those of interest to this project. We also have extensive experience in modeling the thermodynamics, mass transport, and kinetics of the CVD process. The combined efforts are certainly capable of thorough characterization of the deposits.

As an indication of our interest in furthering the science and technology of synthesis of new reagents and their use in the CVD of ceramic coatings we will contribute \$15,000 toward the purchase of a coating adherence tester. In addition we will provide, throughout the duration of the project, the funding for one graduate student at no cost to the Army. This later contribution is equivalent to \$58,604. Thus, the total cost sharing for this proposal equals \$73,604.

## 2.0 Introduction and Objective

This proposal submitted by Clark Atlanta University (CAU) is the result of a teaming effort between this historically black institution and the Georgia Institute of Technology. A new facility to house a Research and Education Center for Science and Technology at Clark Atlanta University has recently been completed. This facility will facilitate interdisciplinary and multidisciplinary approaches to research and development and the attendant education. The center building will contain laboratories and support facilities for research in the following areas:

- Energy Sciences
- Materials Sciences
- Health and Environmental Sciences
- Molecular, Cellular and Developmental Biology
- Computational Sciences
- Engineering Sciences

Clark Atlanta University has established a High Performance Polymers and Ceramics (HiPPAC) Center, which was recently selected for major funding by NASA as a center of excellence, and proposes to develop a Laboratory for Advanced Aerospace Structures (LAAS) that will conduct research on solid mechanics, fluid mechanics, propulsion, and composite materials. There are ongoing research efforts at CAU in the areas of structural dynamics and control and propulsion which are funded by the Propulsion Directorate of the Air Force Wright Laboratories under contract No. F33615-



# Tribological Testing of Ceramic Bore Coatings for Guns

## 1.0 Summary

The objective of the proposed three year project is to perform high speed, elevated temperature pin-on-disk testing of ceramic coatings in order to permit identification and optimization of coatings for the bore of small and large caliber guns. The coatings will be prepared by a separate project described in a companion proposal. The present proposal is divided into three tasks as follows:

- Task 1. Procurement of Wear Tester - In this task a high speed, elevated temperature, pin-on-disk wear tester will be procured. This will require definition of test conditions and equipment features necessary for realistically performing tests that sufficiently mimic conditions in a large caliber gun barrel. Based on interactions with several commercial manufacturers of pin-on-disk wear test machines and Army personnel we will write detailed technical specifications which will be used to purchase the desired equipment.
- Task 2. Tribological Testing - High speed, elevated temperature pin-on-disk and adherence testing will be used to evaluate the wear, friction, and adherence of the coatings generated in the companion coating development program. Many coated samples of varying coating type and possibly substrate type will be generated by the coating program. Those samples which pass visual inspection and judged most promising based on detailed hardness, microstructural, and chemical analyses will be selected for adherence testing. Samples passing the adherence test will be subjected to thorough pin-on-disk wear testing. The state-of-the-art wear tester will permit control of the usual pin-on-disk wear test variables such as load and speed as well as careful control of the temperature and gaseous environment.
- Task 3. Post-Test Evaluation and Modeling - Detailed microanalytical characterization will be performed on tribologically tested samples in order to identify wear mechanisms. Scanning and transmission electron microscopy will be used extensively to compare pre- and post-wear testing microstructural features. Auger and XPS analyses will also be conducted to better understand the nature of the wear surfaces. The identification and structure of wear debris, wear patterns, microcracking and the possible generation of amorphous regions of material will be highlighted. Emphasis will be on identification of the wear mechanisms with a view to suggesting alterations of the coating composition and structure that will result in improved wear resistance. Adherence testing will also be performed on previously wear test samples. Such samples will also be reexamined by micro-analytical characterization methods again with the objective of identifying failure mechanisms and hypothesizing means for improving coating performance. Current physiochemical models for understanding the wear of ceramics and the



adherence of ceramics to metals will be applied and when possible, extended in order to further the mechanistic understanding of the high speed tribology of ceramic gun barrel coatings.

Details of the proposed schedule and milestones appear in Figure 1.

By utilizing staff from Clark Atlanta University and the Georgia Institute of Technology we believe we have assembled a team of experienced investigators possessing the required, specific expertise and facilities to successfully accomplish the proposed tribological research. We have prior experience in tribological testing, and identification and modeling of the wear and adherence of ceramic coatings on metallic substrates. We possess state-of-the-art microanalytical equipment and are experienced in its use in analyzing surface and near surface features of ceramic coatings.

As an indication of our interest in furthering the science and technology of the tribological testing of ceramic coatings for gun barrels we will contribute \$50,000 toward the purchase of a state-of-the-art high speed pin-on-disk wear tester.

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# Organic and Inorganic Aerogels for Aerospace Applications.

P.I.: L. Moeti  
Co-P.I.(s): E. Mintz, M. Mitchell  
Subcontractor: General Dynamics, M. Jones (GDFW), U. Wettermark  
(GDFW), T. Woodrow (GDFW)

## EXECUTIVE SUMMARY

Clark Atlanta University (CAU), a historically black university, is pleased to respond to the Wright Laboratory's request for proposals, solicitation BAA 93-01-93. CAU intends to collaborate with General Dynamics, Fort Worth Division (GDFW) in the development of inorganic and organic aerogel materials. The materials research group at GDFW is interested in the application of aerogel materials in modern aircraft design and fabrication. The collaboration between CAU and GDFW would develop a fundamental understanding of the synthesis and processing of inorganic and organic aerogel materials that could potentially lead to aerogel materials with superior mechanical and optical properties suitable for advanced aircraft applications such as windows and canopies. Other potential aircraft applications of aerogels include low weight insulation around engines and crew stations, and ultra-lightweight optical mirrors.

CAU will conduct research on the development of inorganic aerogels via sol-gel processing. The synthesis effort would focus on the use Aluminum and Zirconium alkoxides to develop aerogel materials with superior mechanical properties. In addition, the synthesis of aerogel materials using Boron Nitride and Silicon Carbide, etc. will also be examined. Synthetic routes to prepare precursor for Ga, Zn, Se, etc. would be explored to develop potential aerogel materials for electro-optic applications (example, ZnSe).

GDFW's effort will focus on the development of organic aerogels based on polyurethanes. Polyurethanes are versatile materials which can be prepared from a variety of precursors and are used as elastomers, rigid structural materials, coatings, or foams. Foams made from polyurethanes can be flexible or rigid depending on the selection of urethane/isocyanate and diol/diamine reagents, catalysts, and polymerization conditions. The synthetic chemistry required to develop rigid but non-fragile polyurethane/isocyanate aerogels with improved mechanical stability would be conducted by GDFW.

During the initial months of this project CAU and GDFW will gain experience in the preparation of silica aerogels using supercritical CO<sub>2</sub> drying techniques. Beginning in year 2 synthetic routes to prepare precursor for Ga, Zn, Se, etc. will be explored to develop potential aerogel materials for electro-optic applications (example,





## Injection Molding of Electrically Active Thick Optically Transparent Panels.

P.I.: L. Moeti  
Co-P.I.(s): M. Mitchell  
Subcontractor: General Dynamics, M. Jones (GDFW), T. Woodrow (GDFW)

### EXECUTIVE SUMMARY

Clark Atlanta University (CAU), a historically black university, is pleased to respond to the Wright Laboratory's request for proposals in research and development, solicitation 93-01-AAKE. CAU proposes to collaborate with General Dynamics, Fort Worth Division (GDFW) in the development of injection molded electrically active thick optically transparent panels. The materials research group at GDFW is interested in the application of electromagnetic shielding properties in thick panels that are optically transparent. The collaboration between CAU and GDFW will develop both a fundamental and applied understanding of the processing and properties of such panels. Envirotech Molded Products will be subcontracted to fabricate the large thick panels using injection molding. CAU will optimize the processing conditions and perform mechanical and physical testing of panel specimens. GDFW will measure the electromagnetic properties and optical transmittance of the injection molded panels and evaluate the applications of the technology.

A team of experienced personnel that could be used to execute the proposed collaborative program has been assembled. CAU would serve as the prime contractor for any proposed research and GDFW and Envirotech Molded Products would be subcontractors. The proposed project director for this program will be Dr. Lebone Moeti (CAU) who is experienced in the processing of materials. The Co-Principal investigator from CAU will be Dr. Mark Mitchell who has expertise in the use of Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS). The collaborators from GDFW will include Dr. Thomas Woodrow who is experienced in the synthesis of novel ceramic/polymer composites and injection molding, and Mr. Mike Jones whose areas of expertise include IR sensor aircraft windows. A postdoctoral fellow and a graduate student at CAU will be used in the execution of the proposed program. Arrangements will be made to have the graduate student spend the summers doing an internship at the Wright Laboratory. One undergraduate student will also assist in conducting research in this program during the academic year.



# **Regenerable Polymeric Reagents for the Preparation of Optically Active Alcohols and Conductive Polymeric Matrix as the Active Component in Sensors for Chiral Molecules**

## **Abstract**

The interaction of chiral molecules and the structural basis for molecular recognition processes are of critical importance to the synthesis and design of effective and safe medicinal agents. For this reason, asymmetric synthesis has become an increasingly important area in organic chemistry.

The first objective of this work is to develop regenerable polymeric reagents for asymmetric reductions. The reagents will be complexes of optically active (chiral) helical polymers and borane. An example of such an optically active polymer is poly(phenyl-2-pyridyl-o-tolylmethacrylate). The presence of the 2-pyridyl groups in the polymer should allow for the preparation of the optically active polymer/borane complexes similar to poly(2-vinylpyridine)/borane complexes. The optically active reducing reagents will be used to reduce prochiral carbonyl functionalities leading to optically active alcohols as the biologically important chloroamphenicol and ethambutol. A detailed study will be carried out to determine the stereoselectivity and chemselectivity of the helical polymer/borane complexes. The second objective of this project is to study the effectiveness of polymers based on the concept of mixed conducting polymers as the active sensor component in a CHEMFET setup. In such conductive polymer matrix, chiral ionophores will be incorporated so that they will complex (molecular recognition) with specific chiral molecules of interest. The overall complexation process will be transduced into electronic signals. In this study, poly[3-methylthiophene-co-3-(polydimethylsiloxane)-thiophene]/chiral polymeric crown ether blends as materials for CHEMFET membranes will be prepared and their effectiveness to detect chiral molecules will be determined.



## **APPENDIX 5**

**"A Forum on Undergraduate Research  
Experiences of Minority Science, Mathematics and  
Engineering Students and A Workshop on  
Graduate School Opportunities"**

***Abstracts of Student Poster Presentations***



**A Forum on  
Undergraduate Research  
Experiences of  
Minority Science,  
Mathematics and  
Engineering Students and  
A Workshop on Graduate  
School Opportunities**

**October 15-17, 1992  
Georgia World Congress Center  
Atlanta, Georgia**



# **ABSTRACTS OF STUDENT POSTER PRESENTATIONS**

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## EXPERIMENTAL MEASUREMENT OF THE PHYSICAL AND MECHANICAL PROPERTIES OF A POLARIZATION OPTICAL FIBER

Author: Lebone Moeti, Samir Moghazy, Al-Amin Ally and Samesha Barnes  
Institution: Clark Atlanta University  
Department: Chemistry and Physics

This project involves the experimental measurement of the physical and mechanical properties of a polarization-maintaining optical fiber. This new fiber has been chosen by NASA-Jet Propulsion Laboratory (JPL) for application in an advanced spacecraft inertial reference unit (IRU) designated as a "fiber-optic rotation sensor" (FORS) and reliability issues regarding long-term unattended use of this new fiber on spacecraft missions need to be addressed. A commercial single-mode optical fiber is being used as a control for all mechanical and physical testing.

Nondestructive evaluation (NDE) using a Dynamic Modulus tester is being done to characterize both the control and polarization-maintaining optical fibers. This technique uses the velocity of sound through a material to determine modulus based on density and structural orientation.

The stress-strain curve of the polarization-maintaining optical fiber is being measured using an Instron Model 4505 for both jacketed and unjacketed fiber samples. The elastic limit (proportional limit) will be determined for both cases. The thermal expansion coefficient of both the jacketed and unjacketed polarization-maintaining optical fiber will be measured as a function of temperature over the range of -50 to +85°C using a Perkin Elmer System 7 TMA with a fiber attachment. The possible changes in the amorphous/crystalline content of polarization-maintaining optical fibers as a result of mechanical testing is being monitored using a Rigaku X-ray diffractometer.

## THE EIGENVALUE MOMENT METHOD: OSCILLATIONS OF THE *VOLCANO* FUNCTION

Author: Kwadwo Appiah and Carlos R. Handy  
 Institution: Morehouse College and Clark Atlanta University  
 Department: Physics

The Eigenvalue Moment Method (EMM) is a novel theory for finding converging lower and upper bounds to the discrete, low lying, spectrum of singular, multidimensional, Schrodinger Hamiltonians. The recent work of Handy, Giraud, and Bessis (Phys. Rev. A 44, 1505, (1991)), has resulted in a dynamical system reformulation of the basic EMM approach, with special emphasis on the importance of an underlying convex function.  $F_E(u) = \text{Min}_{\sigma=0,1} \langle V^\sigma[u] | M_{\sigma,E}[u] | V^\sigma[u] \rangle$ , referred to as the *volcano function*. It is known that the maximum of this function,  $V(E) = \text{Max}_u F_E(u)$ , oscillates with respects to its E-dependence. Based on an earlier work by Handy and Lee (J. Phys. A; Math. & Gen. 24, 1565 (1991)), it is argued that the various local maximas of  $V(E)$  are determined by the location of the excited states of the system.

This research is partially funded by the National Science Foundation (RIMI/CTSPS) to Clark Atlanta University.

**HAZARDOUS WASTE MANAGEMENT AND MINIMIZATION  
AT THE NATIONAL RENEWABLE ENERGY LABORATORY  
GOLDEN COLORADO**

Author: Anita L. Archibeque  
Institution: New Mexico Highlands University  
Department: Environmental Science

The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado. It is the national center for federally sponsored renewable energy research and development in the following areas: biofuels, building energy (residential and commercial), energy storage, photovoltaics, solar thermal energy, solar buildings and wind energy. Hazardous waste generation is a product of the research and development activities at NREL and waste management and minimization is an extremely important component of these laboratories activities. Hazardous waste management and minimization is reviewed.

## PURIFICATION AND CHARACTERIZATION OF AMIDASE FROM *PSEUDOMONAS* sp.

Author: Jamy Ard\*, M.S. Nawaz\*, J.E. A. Leaky+, and C.E.  
Cerniglia\*  
Institution: Morehouse College  
Department: Biology

Acrylamide is a well documented neurotoxin, mutagen, teratogen, suspected carcinogen, and possible cause of other human health hazards. A strain of *Pseudomonas* isolated from farm soil was found to be capable of utilizing acrylamide as its sole source of carbon and nitrogen. An aliphatic amidase is responsible for the degradation of the acrylamide to ammonia and acrylic acid. The enzyme was purified approximately 17-fold by primarily using fast protein liquid chromatography (FPLC). Total yield was less than 10% of the original crude extract, but the specific activity was 15-fold higher. Homogeneity is not far from being achieved. Once the enzyme has been purified to a homogeneous band as indicated by SDS-polyacrylamide gel electrophoresis, studies will begin to characterize and immobilize the enzyme for bioremediation.

\*Division of Microbiology; Risk Assessment and Biometry, NCTR

## COMPUTERIZATION OF ABSOLUTE MOLECULAR WEIGHT ANALYSIS PROCEDURE

Authors: Joseph Kosman and Stephanie Armstrong  
Institution: Winston-Salem State University  
Department: Physical Sciences

British Petroleum needed a rapid method for performing molecular weight analysis. The current method involved testing several concentrations of the polymer using a differential refractometer and then manually plotting the refractive index versus the concentration in order to determine the  $(\Delta N / \Delta C)$ . For complete molecular weight analysis, Zimm plots on each concentration were performed. This process takes about 10 days to perform molecular weight analysis on one sample. The new method is completely computerized, and requires only three simple steps; injection of the sample, data input, and data retrieval.

The experimental set-up consisted of a Tecator, mass detector, and a laser-light scattering unit. Once the sample is injected the computer collects all the data, and calculates the molecular weight from the peak areas, peak start and stop time, and from the concentration injected.

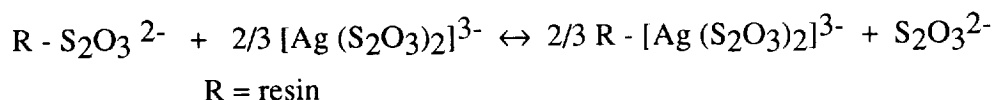
In order to test the accuracy of the system we injected ten polystyrene standards, and calculated the percent error. The error was determined to be less than 10% in all cases. Finally, a broader polymer standard, polymethacrylate, was tested. Again, the percent error was less than 10%.

The new method is faster without sacrificing accuracy, it lowers the analysis cost by at least \$1,000.00, and the results are easily reproducible.

## ION EXCHANGE RESINS FOR SILVER RECOVERY

Author: Amy Arthur, Paul Abrahams, Kenville Grimes, Eric Mintz,  
 Institution: Clark Atlanta University  
 Department: Chemistry

Silver recovery in the photograph industry is important for both economic and environmental reasons. One of the current methods of recovery involves the adsorption of silver thiosulfate from the complex as shown below



We have examined the silver adsorption efficiency of four ion exchange resins, SR-3, IRA-68, IRA-400, IRA-458, for silver recovery in the presence of thiosulfate ion. We have also examined kinetics of silver uptake of these resins. The results of this work will be described. This work was carried out with support from Eastman Kodak Company.

## PRIME NUMBERS AND CHAOS

Author: Zabiollah Azadi  
Institution: Tennessee State University  
Department: Mathematics

The apparent randomness of the distribution of the prime numbers has stimulated an interest in applying Chaos Theory techniques, such as forward iterations to the enumeration of the primes. As background material the paper includes a detailed proof of the Prime Number Theorem following Selberg. The proof is illustrated by sufficient explanation and examples to make it accessible to the undergraduate mathematics major. The preliminary theorems and observations that indicate that the behavior of the primes might be chaotic are also included.

## RELIABILITY OF GAS PIPELINES UNDER VEHICULAR CROSSINGS

Author: Elizabeth Barraza and Carlos Ferregut  
Institution: University of Texas at El Paso  
Department: Civil Engineering

Analysis and design of gas pipelines under crossings have traditionally been conducted using deterministic values for all the design variables involved. Specific values for those design variables are chosen as the average, the maximum or the minimum values observed, or the value associated with certain probability of occurrence.

During this project, a practical approach, that accounts for the variability of the design variables, was developed for the analysis and design of gas pipelines under vehicular crossings. General sources of uncertainty in each variable are discussed and modeled using second order statistics (mean and coefficient of variation). A statistical parameter data base was compiled from published and unpublished reports. The methodology proposed in this paper allows for the quantification of the reliability level of a given pipe design. The model observes two possible failures of gas pipe: (1) exceeding the allowable yield stress on a given section under combined stresses; and (2) exceeding the allowable yield stress under external loads.



## SOIL CHARACTERIZATION STUDY RELEVANT TO CONTAMINANT MIGRATION

Author: Chukwu Onu and Charles E. Bethley  
Institution: Southern University, Baton Rouge  
Department: Chemistry and Center for Energy and Environmental Studies

The morphology and chemical properties of soil from the Department of Energy Pacific Northwest Laboratory were investigated. The soil characterization study utilized standard soil characterization methods as set forth by the American Society of Agronomy, Inc. and the Soil Society of America, Inc. Soil characterization data are essential in assessing contaminant migration and/or interactions in the subsurface environment. The principal soil characterization parameters investigated included moisture content, pH, bulk density, organic matter content, cation exchange capacity, carbonate content, and particle size distribution. Analysis of the soil characterization data indicated limited contaminant migration influence and/or contaminant/soil interactions by all the investigated parameters, except cation exchange capacity, which is discussed.

## THE EVALUATION OF SOLVENT EVAPORATION TIMES AND EFFECTS ON 3M DISPOSABLE INFRARED CARD

Author: Jim Gagnon\* and Andrea Bowens  
Institution: Clark Atlanta University  
Department: Chemistry

Salt plates have been used almost exclusively for analysis using the Infrared Spectrometer. Problems arise with cleaning salt plates, which can result in cross contamination. There is also the possibility of a reaction between the salt plate and various solvents. The general purpose 3M Disposable IR Card (DIRC) is routinely used for qualitative analysis of organic solvent based solutions or mixtures where rapid evaporation of the volatile components permits easy analysis of less volatile material. However, in many cases evaporation times are sufficiently long to be detected by the FTIR.

Solvent evaporation times, as well as the solvents effects upon the thin microporous polyethylene were studied using a wide variety of volatile to semi-volatile chemicals. Small, known quantities of these chemicals were applied to the sample application area of the 3M DIRC. The time for total solvent evaporation was determined. Infrared spectral characteristics of the baseline and polyethylene absorbances were compared for the various solvents tested. Conditions affecting the total evaporation time were also investigated. This work was carried out under an internship at 3M Company, St. Paul, MN

\* 3M Company, Disposable Products Division, 3M Company, St. Paul, MN

**UTILITY ROUTINES FOR LANGUAGE/TOPIC IDENTIFICATION  
AND INFORMATION  
RETRIEVAL OF FAX IMAGES**

Author: Nazir Warsi and Eric Brittain  
Institution: Clark Atlanta University  
Department: Computer Science

This project involves implementing several utility routines for a filtering system "What Doc's Up?" developed at MIT-Lincoln Laboratory. Using a simple similarity definition, the system facilitates the selection and retrieval of messages based on topic or text language. It is capable of identifying related items in a large body of machine-related text in any language without prior topic specification. In order to use this retrieval system on fax images, several routines are needed to convert text-based fax images into machine readable text.

The proposed project is Unix-based, utilizing the facilities of C, the Sun Windowing System, and fax/modems. It also uses the PBM/PLUS Graphics Package. Specific tasks include:

1. The removal of noise around the borders of fax documents, providing input to the parse character routine;
2. The development of a parse character routine to locate each character on the page;
3. The comparison of all the characters in the document against themselves to determine their similarity;
4. The development of several output techniques to determine the success of each comparison routine; and
5. The compilation of several images on one page for easy viewing.

Support provided in part by the Department of the Navy grant number N0001489J3229 to Clark Atlanta University.

**ACCEPTOR CHARACTERIZATION OF UDP-GalNAc:  
POLYPEPTIDE, N-ACETYLGALACTOSAMINYLTRANSFERASE**

Author: Erika Brown\* and A. Elhammer<sup>a</sup>  
Institutions: Spelman College\* and Upjohn Laboratories, Discovery  
Research Division, Kalamazoo<sup>a</sup>  
Department: Biology

A glycosyltransferase known as N-acetylgalactosaminyltransferase has been shown to glycosylate synthetic peptide sequences *in vitro* with the sugar UDP-GalNAc (Uridine-5'-diphospho-N-acetylgalactosamine), via the process of O-linked glycosylation. The enzyme shows specificity for amino acid sequences which contain either serine or threonine residues. Five synthetic peptide sequences were made to aid in characterizing the peptide sequences for which this enzyme shows specificity. Assays were performed in which the synthetic peptides were allowed to be glycosylated *in vitro*, and the amounts of glycosylated product were obtained and evaluated. The results showed that glycosylation under *in vitro* conditions favors linkage with threonine residues thirty-five times greater than serine residues.

## **RADIATION EFFECTS ON A FLOATING - GATE ISOLATION TRANSISTORS IN GATE ARRAYS**

Author: Kenneth A. Brown, Gary Swift,\* and George Soli  
Institution: Clark Atlanta University and Jet Propulsion Laboratory\*  
Department: Graduate Physics

The purpose of this project is to determine the effect of a floating isolation transistor on the performance of gate arrays before and after radiation. Proton tests were performed which induced a positive charge on the gate of a floating gate n-MOSFET. The results were compared to SPICE simulations and to the Cassini radiation environment. It was concluded that the effect would be small if the overlayer oxides retain the charge; however, since the charge anneals the hazard is not significant for the Cassini environment and the n-MOSFET tested.

This research is partially funded by the National Science Foundation (MRCE/CTSPS) to Clark Atlanta University.

## AIR EMISSIONS INVENTORY

Author: Holton Buggs, Jr.  
Institution: Texas Southern University  
Department: Engineering Technology

The purpose of this inventory is to demonstrate the National Institute for Petroleum and Energy Research's (NIPER) compliance with legal and regulatory requirements imposed by federal, state, and local agencies.

On June 3, 1992, I began to implement an air emissions inventory to document and quantify all airborne released hazardous air pollutants and ozone depleting substances including: volatile organic compound storage, gasoline, and diesel fuel, chloroflorocarbons and other chemical substances. The inventory also consisted of the source by which the pollutants are extracted, such as: fume hoods, boilers, heating and A.C. units, and other equipment. A chemical inventory which consisted of the volume of HAPs depleted in a six-month period was performed to estimate the amount of the facility's annual HAP deletion.

After assessing all of the chemical substances, the Oklahoma Clean Air Act and the material safety data sheets were used in classifying each chemical according to its toxicity level.

**FUNCTIONAL ANALYSIS OF THE PERIODIC  
IMMUNOPROTECTIVE POTENTIALS OF ANTI-PORIN  
MONOCLONAL ANTIBODIES IN EXPERIMENTAL MURINE  
SALMONELLOSIS**

Author: S. R. Singh, Yvonne Williams and Shuntele Burns  
Institution: Alabama State University  
Department: Biology

The outer membrane (OM) of *Salmonella typhimurium* and other gram-negative bacteria contains a family of pore-forming proteins called porins that facilitate the passive diffusion of small, hydrophilic molecules across the outer membrane. This investigation was designed to assess the immunoprotective potentials of anti-(*S. typhimurium*) porin monoclonal antibodies (MAbs) using the murine *Salmonellosis* model system for the study of human typhoid fever. Groups of BALB/c mice were immunized with a panel of 3 auto-OmpD (trimer), 6 anti-OmpC (Trimer), 4 anti-OmpD (monomer) and 4 anti-OmpC (monomer) MAbs which have been shown to bind epitopes that are either exposed on the bacterial cell surface or buried in the OM bilayer. These mice were challenged 60 min later with 2 LD<sub>50</sub> values of the OM from the virulent *S. typhimurium* LT-2 strain WB600. The protective efficacy of anti-porin MAbs and the relationship of the MAb isotype and the immunoglobulin level of MAbs (ascites) with immune protection observed was determined from the 21-day survival data. The results obtained so far indicate that the MAbs specific for the cell surface epitopes prolong the survival of test animals and therefore, the major OM proteins may be useful as vaccines against *S. typhi* infections. This research was supported by NIH Grant GM08167, Alabama State University.

**THE CLONING OF THE PRP6+ GENE OF THE FISSION YEAST  
*SCHIZOSACCHAROMYCES POMBE***

Author: D. Frendwey\*, R. Massey\*, and Bennetta Marchelle Cannon<sup>a</sup>  
Institution: \*New York University Medical Center & <sup>a</sup>Xavier University of  
Louisiana  
Department: Microbiology

The goal of my project is to clone the *prp6+* gene of the fission yeast *Schizosaccharomyces pombe*. The *prp6+* gene was identified by a mutation in the temperature sensitive (*ts-*) mutant *prp6-1*. The mutation causes poor growth and inefficient splicing of mRNA precursors (pre-mRNA) at 37°C. Previous investigations have shown that the *ts-* mutation and the pre-mRNA splicing mutations are closely linked. If the *ts-* mutation can be cured through transformation, then the splicing defects can possibly be cured enabling gene expression to occur in a more efficient manner. Attempts were made to clone this gene by functional complementation. The mutant was transformed with a library of *S. pombe* genomic DNA. Transformants were tested for their ability to be grown rapidly at 37°C. This screening produced 24 possible positive transformants. Fourteen (14) were chosen after secondary screening. Plasmid DNA was prepared from these and will be used to transform *E. coli*. DNA recovered from *E. coli* clones will be analyzed by digestion with restriction enzymes. To confirm that the *prp6+* gene has been cloned, the cloned DNA will be tested for its ability to cure the *ts-* growth and splicing defects in the *prp6-1* mutant.



## DESIGN OF DUCTILE-PHASE REINFORCED CERAMIC COMPOSITES

Author: Maritza Carballo  
Institution: Florida International University  
Department: Mechanical Engineering

My project at Oak Ridge National Laboratory involved working with the Structural Ceramics Group in the design of ductile-phase reinforced ceramic composites. The objective of the investigation was to understand the effects of the different processes used in developing the ceramic composites and to manipulate the microstructure of these ceramics in order to achieve improved fracture toughness and better mechanical properties. Specifically, the majority of the work involved the fabrication, testing, and evaluation of the nickel aluminide - alumina ceramic composites. The goal of the project was to achieve toughening of the material by bridging the cracks with the reinforced metallic phases which plastically deform in the wake, or tip of the crack. The investigation involved working with state-of-the-art Scanning Electron Microscopes and other advanced fabrication and testing equipment.

**NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)  
COMPLIANCE AT BATTELLE PACIFIC NORTHWEST  
LABORATORIES**

Author: Ana Maria Castillo  
Institution: University of Texas at El Paso  
Department: Civil Engineering

The National Environmental Policy Act (NEPA) of 1969 established a national environmental review policy and requires all federal agencies to fully consider and disclose environmental concerns for protection of the natural environment.

The purpose of the National Environmental Policy Act Program Plan manual is to provide a general overview of the NEPA review process at Battelle Pacific Northwest Laboratories (PNL) and to serve as guide for all personnel working on proposed projects through the NEPA review process at PNL.

NEPA reviews at PNL have become the turning point that determines whether a proposed project can be initiated. Compliance with NEPA requirements will ensure that the proposed project is reviewed for possible harm to humans, wildlife, and the environment, and that any waste generated during development, construction, and operation of the project will be properly disposed.

## CONCENTRATION, ANALYSIS AND IDENTIFICATION OF SOME SECTOR OF THE LAGOONS SYSTEM IN HUMACAO

Author: Sonia L. Vázquez-García, Wendra Collet, Olga Jaca  
Institution: University of Puerto Rico, Humacao  
Department: Chemistry

The Estuary and the Lagoons System of Humacao is used among others, as a fishing place by many residents living near the area. The Frontera Creek is part of the system, and crosses two of the lagoons. Some areas were selected to be sampled in the creek and in the two lagoons, in order to determine if some organic pollutants of the creek are having access to the two lagoons.

The non-polar organic compounds were concentrated in a small column of octadecilsilane. The volume of the water pumped through the columns was optimized to have the largest retention of these compounds. The concentrated organic compounds were eluted and then analyzed and identified with a GC-MS. The design of the next stage of sampling and analysis will also be presented.

## REMOVAL AND CONTAINMENT OF RADIOACTIVE WASTE

Author: Richard Davis  
Institution: Florida International University  
Department: Mechanical Engineering

Due to the support of **The Environmental Technology and Waste Management Consortium, and Associated Western Universities**, I was given the opportunity to spend my summer at Oak Ridge National Laboratory as an assistant to the head engineer of the Chemical Technology Engineering Support Division in the removal and containment of hazardous materials. One of the tasks performed, was the design of the drive system for an experimental microwave scabbling mobile unit. This unit will be used to remove radioactive particles embedded in concrete. This was done by exposing the contaminated concrete to an intense microwave field, thus turning it into a fine powder. This contaminated powder can then be removed and contained, leaving the remaining structure intact. Part of my work also involved designing and building a prototype low level liquid waste bottling station. This station will be used to remove low level liquid wastes from the drains of laboratory hoods at a low cost without compromising safety.

## **MODULATION OF GROWTH AND DIFFERENTIATION OF HUMAN RETINAL CELL LINE BY GROWTH FACTORS**

Author: Bryan Derrison, I. Ezeonu and K. Dutt  
Institution: Morehouse College and Morehouse School of Medicine  
Department: Biology

As a model for ocular diseases, our lab has successfully established a variety of ocular tissue cell lines by gene transfection. We have developed a human retinal cell line by transfection with the SV40T gene; the cell line is very stable and expresses a variety of neuronal markers. We have in the past been able to modulate differentiation in these cells by such inducers as cAMP, TPA, NGF, etc. In this study, we have explored a variety of growth factors for their mitogenic and differentiation potential. Cells in passage 26 were treated with epidermal growth factor (EGF) - 1-100ng/ml, Basic fibroblast growth factor (bFGF)- 1-100ng/ml, Nerve growth factor (NGF) - 1-100ng/ml, Transforming growth factor alpha (TGF $\alpha$ ) - 1-100ng/ml, Transforming growth factor Beta (TGF $\beta$ ) 2-10ng/ml and Platelet derived growth factor (PDGF) - 2-10ng/ml. Cells were evaluated for phenotypic changes and mitogenic activity was measured by  $^3\text{H}$ -Thymidine incorporation. Preliminary studies suggest that bFGF and TGF $\beta$  act as mitogens, whereas EGF, TGF $\alpha$ , PDGF, and NGF induce neuronal differentiation. Studies are in progress to evaluate the synergistic effects of some of these compounds. These and other data will be presented.

## CROSS-REACTIVITY OF A DEFINED ANTI-PEPTIDE ANTIBODY WITH SCHISTOSOME ANTIGENS

Author: F. Desilva, J. W. McCray, Jr., M. M. Petzke, S. Ranji, J. Kurtis, M. Goldberg and P. M. Knopf\*  
Institution: Morehouse College and Brown University  
Department: Biology

Immunoscreening of a (1)-g11 [*Schistosoma mansoni*] adult cDNA expression library previously identified clones producing (b)-galactosidase fusion proteins uniquely reactive with antibodies in protective rat serum F-2x. A rabbit antiserum generated in our lab against the fusion protein of cDNA clone (1)-40 has been shown to specifically react with a family of biosynthetically radiolabelled soluble protein antigens of juvenile worms, 18-22 kDa, also uniquely reactive with F-2x. This highly radioactive antigen family was a minor species of the worm soluble protein mass, determined by silver-staining of 2D-gels. A genomic clone (GP22) encoding the sequence present in (1)-40 was subsequently identified (El-Sherbeini, et al., 1991). Computer-predicted B cells epitopes of the proteins encoded by gene GP22 included a sequence of 12 amino acids, called peptide delta ((d)), in the region coinciding with (1)-40. Peptide (d) was chemically synthesized, coupled to ovalbumin, and used to immunize 3 rabbits. Anti-(d) was purified from each antiserum over a peptide affinity column and reactivity with schistosome antigens analyzed. All 3 anti-(d) preparations reacted on ELISA with the synthetic peptide and with antigen in the juvenile worm soluble extract (S2). Two anti-(d) preparations were used to analyze fractions of S2 following separation by size and composition on a lentil lectin-Sepharose column. Both reacted with a nonbinding, high molecular weight (MW) component >60 kDa. Anti-(d) and F-2x reacted strongly with high MW antigen (ca. 100 kDa, doublet) in juvenile worm S2 by immunoblotting, following gel electrophoresis under denaturing conditions; anti-(d) also reacted weakly with antigen in the size range encoded by the open reading frame in gene GP22, ca. 20 kDa, but only after concentrating the S2 fraction. Existence of an epitope on the high MW antigen which is cross-reactive with anti-(d) is an unexpected result and current studies are addressing this issue. (Supported by NIH A131225 and WHO B20/181/53)

## LITHIUM TECHNOLOGY; AN AUSPICIOUS FUTURE

Author: Corey Cordell Echols  
Institution: Clark Atlanta University  
Department: Physics

This report was written to assist the Department of Energy in its efforts to identify potential industrial partners in lithium technology. The Department of Energy has 80 million tons of raw metallic lithium and lithium compounds which they want to put on the market to be sold to major lithium consumers. The purpose of this report was to enlighten the Department of Energy to the recovery processes, production, consumption, suppliers, and consumers of metallic lithium and also the promising future of the lithium market. Several prospective future applications of lithium are also discussed.

**DETERMINING HOST SUITABILITY, AND HOST  
ACCEPTABILITY IN *HEMILEUCA MAIA***

Author: Peter Martinat, Bennetta Cannon, Erica Caesar and Temeika L. Fairley  
Institution: Xavier University of Louisiana  
Department: Biology

*Hemileuca maia* (Drury), the buck moth, has been a pest to both trees and humans in urban areas of southern Louisiana for years. The principle host appears to be live oak.

We conducted experiments to determine the host plant suitability and acceptability of the caterpillars on nine common tree species. Preliminary data suggest that buck moth caterpillars do well (in terms of development time and weight) on at least three oak species: live oak, water oak and black oak. Since pupal weight has a high correlation with female fecundity, this translates into higher reproductive rates for individuals reared on these trees. Water oak appears to be the most suitable host. Choice tests with newly hatched first instars revealed some unexpected information. In the black oak choice test, black oak was the preference over water oak and cherry, but not live oak. The choice test with water oak showed water oak to be the preference over live oak, red maple, and cherry. The preference of black oak and sweet gum over water oak was unexpected, considering the previous results.



## THE INTERACTION OF CHLORPROMAZINE WITH PHOSPHOLIPID MULTILAYERS

Author: Maximilian R. Fernandez, Hendrik Keyzer, Melvin K. Dea, and  
Phoebe K. Dea  
Institution: California State University, Los Angeles  
Department: Chemistry and Biochemistry

High-sensitivity differential scanning calorimetry was used to study the effects of increasing concentrations of chlorpromazine hydrochloride (CPZ.HCl) on the thermotropic and polymorphic properties of two phospholipid multilayer systems: dipalmitoylphosphatidylcholine (DPPC) and dipalmitoylphosphatidylglycerol (DPPG). Changes in the phase transition temperature ( $T_m$ ) and cooperativity of the lipid systems were investigated with respect to the amount of chlorpromazine present. Low concentrations of CPZ.HCl have a more pronounced effect in DPPG than in DPPC. As the CPZ.HCl concentration is increased further, a pattern of a lowered  $T_m$  and phase changes over a broad temperature range emerges in both lipid systems.

## CONGESTION CONTROL IN ATM NETWORK

Author: Herman Hughes, T. Wesley and Michelle Foy  
Institution: Fisk University  
Department: Mathematics and Computer Science

Increased demand for new and fast communication services has manifested an interest in the area of high-speed telecommunication networks such as Broadband Integrated Services Digital Network (BISDNs). Asynchronous Transfer Mode (ATM) is considered to be the most promising transport layer protocol to support broad-band ISDN. How to control congestion in ATM network has become an important research issue.

The purpose of this research was to analyze some of the existing techniques for congestion control from published research papers. The leaky bucket algorithm was the emphasis of our research for cell level congestion control. Using a C-based simulation program CSIM, the performance of the leaky bucket algorithm was evaluated by running geometric distributions on the simulation model.

## MINERALIZATION OF CHRYSENE AND HEXADECANE WITH SIX CONSTRUCTED MICROBIAL MATS

Authors: Peter Phillips,\* Neysa Foy\* and Jack Word<sup>a</sup>  
Institutions: Clark Atlanta University\* and Battelle Marine Science  
Laboratory  
Department: Biology

Six constructed microbial mats, in different combinations of blue-green algae (cyanobacteria) and bacteria, degraded hexadecane and chrysene. In a light and dark series, the microbial mineralization (measured as CO<sub>2</sub> levels absorbed by a KOH trapping agent) of <sup>14</sup>C-labelled hexadecane and chrysene was monitored by liquid scintillation counting to 28 days. <sup>14</sup>CO<sub>2</sub> production measurements in the light flasks were confounded by possible re-incorporation by the photosynthetic cyanobacteria.

After the first 24 hours, <sup>14</sup>CO<sub>2</sub> amounts in the KOH traps were higher in the test tubes maintained in the dark than in those test tubes maintained in the light. By day 14, several of the chrysene light readings were zero. Throughout the experiment, readings were higher in the hexadecane series than in the chrysene series. In those microbial mats containing raw silage, <sup>14</sup>CO<sub>2</sub> counts were usually higher. All pure *Oscillatoria* sp. mats generally had the lowest counts.

During the first 24 hours, mineralization rates ranged from 0.01-0.04 ng/h for chrysene light series to 1.5-12.2 ng/h for hexadecane light series. Dark series values for the same time period ranged from 0.01-0.10 ng/h for chrysene and 3.0-27.6 ng/h for hexadecane. Daily mineralization rates, by day 28, ranged from 0.022-0.644 ng/day in the chrysene light series to 3.6-100.4 ng/day in the hexadecane light series. Dark series value for the same time period ranged from 0.494-2.998 ng/day for chrysene and 63.2-1232.8 ng/day for hexadecane. During 28 days, the percent mineralization was significantly greater for hexadecane compared to chrysene. Light series values ranged from 0.01-0.08% for chrysene and 0.47-3.07% for hexadecane. Dark series values ranged from 0.14-0.21% for chrysene and 4.65-14.29% for hexadecane.

## **THE ADSORPTION BEHAVIOR OF HUMIC ACID ON VARIOUS ADSORBENTS AT DIFFERENT pH'S**

Author: Danielle France, Shawn Gainor,  
Institution: Hampton University  
Department: Chemistry

In environmental water systems, humic substances are of special interest because they act as organic precursors to the formation of halogenated by-products, such as trihalomethanes. These substances may have chronic health risks and carcinogenic effects. River sediment and activated carbon serve as adsorption sites and complexing agents for humic acid and other inorganic ions in solution. Knowing the behavior of this adsorption phenomenon would assist in the understanding of treatments in water columns.

The adsorption behavior of humic acid on river sediment and activated carbon, with variations in pH, was observed experimentally. For both, results conclude that as the pH decreases there is an increase in the adsorption capacity of sediments. However, for river sediment, further studies are necessary to investigate why the values of  $K_d$  fluctuate over the range of pH.

## MATE CHOICE IN A CICHLID FISH

Author: Charles Freeman  
Institution: Morehouse College  
Department: Biology

A laboratory study was conducted to evaluate the criteria used by female *Tipapia nilotica* in choosing mates. Mate choice was evaluated by placing fishes in a three chambered aquarium. The three chambers were separated by screen mesh which permitted water flow as well as visual, and auditory contact. In each experiment a reproductively mature male was placed in each end chamber and a choosing female was placed in the center chamber. The amount of time the female spent on each side of the center chamber, near one male or the other, was deemed to indicate choice of female. Both male body size (age) and familiarity between a male-female pair were to be evaluated. The experiments I have conducted to date indicate that females prefer large males significantly more than small males. A total of 64 trials were performed with six females and twelve males. Females spent a significantly greater proportion of time near a large male than a small male when given a choice between a large and small male. In these experiments, females had no prior experience with either male. This response by females was strongest in the initial trials with a given set of two males and a female. I will continue this study by creating small male-female pairs that will have been held in a two chamber holding tank prior to the experimental trials. In this manner, males who are at a disadvantage in mate choice will be most familiar to the choosing female. I wish to determine whether familiarity will counter male body size as the principal criterion for female choice.

## HYDROLOGY OF SHALLOW LAND BURIAL

Author: Armando C. Furlano  
Institution: New Mexico Highlands University  
Department: Environmental Science

The amount of low level radioactive waste is conservatively projected to be 16 million M<sup>3</sup> by the year 2020. The current disposal method for this waste is by shallow land burial. Los Alamos National Laboratories has many ongoing studies that pertain to the hydrology of land fill covers. The covers that are placed on this waste must minimize soil water migration. Different vegetative species and soil profiles are being tested at LANL. The current studies on shallow land burial are soil moisture data (e.g. infiltration, seepage, runoff, inter flow, and canopy vs. inter-canopy regions) and vegetative coverings (what would be the most opportunistic plant covering). The integrity of shallow land burial covers is of paramount concern because these sites will not always be controlled by the government.

## PINION-JUNIPER ECOLOGICAL DATABASE

Author: Fairley Barnes and Crystal H. Furlano  
Institution: New Mexico Highlands University  
Department: Environmental Science

Height and basal diameters measurements were taken on all Pinion and Juniper trees, as well as porometry measurements on selected trees within a 100 by 150 meter area located within the Los Alamos Environmental Research Park. These evaluations will be used as a database for the physiological properties of these trees for future soil water models. The National Environmental Research Park at Los Alamos National Laboratory is used to maintain and extend an advanced capability for measuring and modeling physical, chemical, and biological processes in ecosystems and to use this capability to derive practical, empirically-based technology for assessing and resolving environmental issues.

## A COMPARATIVE STUDY OF TWO METHODS OF TOXICITY TESTING

Author: Shawn Gainor  
Institution: Hampton University  
Department: Chemistry

The Topkat Program and the Microtox Toxicity Testing System are two methods used to detect the toxicity of chemicals. The Topkat Program is a computer program designed to evaluate the toxicity of a given chemical based on its structural formula. The computer matches the given structural formula with those found in its data library and determines whether the chemical is a carcinogen, mutagen, or eye irritant and assigns a LD<sub>50</sub> value.

The Microtox Toxicity Testing System is able to determine the toxicity of a chemical by measuring the difference in the light readings of luminescent bacteria before and after exposure to a chemical. An EC<sub>50</sub> value is obtained from the data.

In this research study, the usefulness of the Topkat Program and the Microtox Toxicity Testing System is compared and evaluated using acetone, methylene chloride and isopropanol.



## TERNARY PHASE DIAGRAMS FOR POLYIMIDE SOLVENT/NON-SOLVENT SYSTEMS

Author: Enid Gatimu, H. Marand\*, T. Lin\*  
Institution: Clark Atlanta University  
Department: Chemistry

This discussion will focus on the determination of phase diagrams for ternary polyimide/solvent/non-solvent systems in order to define solution compositions for which particle formation by precipitation is possible. These phase diagrams were obtained by the application of the cloud point technique where an infinitesimal change in non-solvent concentration would result in phase separation. Three different variables for the determination of the diagrams will be discussed namely molecular weight variation, chemical structure and the effect of solvent and non-solvent with different polarity and hydrogen bonding capability.

The contribution of this work in the overall research is the finding of a solvent/nonsolvent pair that produces a low volatility solution for particle formation using spray drying techniques.

This work was carried out under a summer internship at the Virginia Polytechnic Institute and State University

\* Virginia Polytechnic Institute and State University

## ISOLATION AND CHARACTERIZATION OF A MYCOBACTERIUM LEPRAE GENE ENCODING A 64kDa PROTEIN

Author: Gregory T. George and Sandra K. Davidson  
Institution: Morehouse College and Morehouse & School of Medicine  
Department: Biology

Recombinant DNA technology has recently been applied to the study of *Mycobacterium leprae* (*M. leprae*) and has resulted in the isolation of recombinant clones encoding antigens of this uncultivable pathogen. We have screened a genomic library of *M. leprae* in the expression vector lambda gtl1 (provided by Dr. R.A. Young, Whitehead Institute) with polyclonal rabbit antisera elicited by a cell extract of *M. leprae*. We isolated numerous reactive clones by this immunoscreening and all of them were nonreactive with monoclonal antibodies to previously characterized *M. leprae* antigens. Through the use of Western blotting we have shown that a previously uncharacterized recombinant clone expresses a fusion protein with an antigenic determinant of a *M. leprae* 64kDa protein. Also, by Southern blotting of restriction endonuclease digested phage DNA we have demonstrated that these sequences are not homologous with DNA encoding the well-characterized, immunodominant 65kDa protein. We are currently sequencing this *M. leprae* DNA and plan to compare the complete sequence with those contained in GenBank.

Supported by NIH S06GM08248.

## GEOMAGNETIC STORM PREDICTION ON A NJ ELECTRIC POWER GRID

Author: Lou Lenzerotti, Dave Thompson and Henry Hayes  
Institution: Clark Atlanta University  
Department: Mathematical Sciences

The effects of geomagnetic storms on a Philadelphia Electric Co.'s electric power grid were investigated to determine if these "storms" could indeed be predicted. Geomagnetic storms cause electrical power outages across large areas by inducing electrical currents in the windings of power transformers. With three minute time delays, a forty-five minute linear fit of the earth's magnetic field components, H, D, and Z, proved most effective in predicting the next fifteen minutes of the observed current levels on the power grid. The D prediction coefficient's consistency illustrate that there is a direct correlation between changes occurring first in the magnetic field and subsequent changes in the current levels on the power grid. The D component could possibly foretell upcoming "storms" not only on electric power grids, but also on transatlantic cables and pipelines. Smaller nonlinear fits are believed to provide finer resolution of the geomagnetic storm itself.

**IMMUNOCYTOCHEMICAL CELL IDENTIFICATION AND  
DETECTION OF CYTOKINES AND VIRAL ANTIGENS IN  
MUSCLE AND CNS TISSUE OF HTLV-I INFECTED  
INDIVIDUALS**

Author: Lia M. Haynes,\* C. A. Mora, C. J. Gibbs, Jr. and D. C. Gajdusek<sup>a</sup>  
Institutions: Spelman College\* and National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD<sup>a</sup>  
Department: Biology

Immunocytochemistry was performed on infected tissue from polymyositis and endemic tropical spastic paraparesis/HTLV-I associated myelopathy (TSP/HAM) patients. Immunoalkaline phosphatase technique was used to stain cryosections and paraffin-embedded sections for HTLV-I envelope gp46 antigen, HTLV-I core protein p19 antigen,  $\gamma\delta$  T-cell receptors, TNF- $\alpha$ , CD4, CD8, major histocompatibility factor type II (MHC-II) and macrophages. Preliminary results show that the polymyositis tissue stained positive for TNF- $\alpha$ ,  $\gamma\delta$  TCR, CD4, CD8, HTLV-I gp46 and HTLV-I p19 antibodies. In contrast, the TSP/HAM tissue stained negative for TNF- $\alpha$ , CD4, CD8, HTLV-I gp46, HTLV-I p19, MHC-II and macrophage antibodies and only showed slightly positive staining for  $\gamma\delta$  TCR. There are several variables that may have caused the negative staining of cellular antigens, as well as HTLV-I viral antigens in the HTLV-I infected CNS and muscle tissue of show that HTLV-I, through cytokine-mediated activity, is a causative agent in polymyositis.

## **FINDING A SHORT, YET EASY METHOD TO SOLVE PARTIAL DIFFERENTIAL EQUATIONS**

Author: Corliss D. Heath  
Institution: Clark Atlanta University  
Department: Mathematics

Solving mathematical problems can sometimes seem long and quite tedious. But why does it seem impossible to solve problems in mathematics?

Often times, students are intimidated by mathematical equations. Some feel that mathematics is hard and that it "can't" be done. But there are easy ways to solve mathematical equations, even those that may appear difficult, such as partial differential equations. There are several methods that can be used to solve partial differential equations. The methods that will be used for this research are the wave equation, the heat equation, and the concept of approximation. The use of these three methods will demonstrate the simplicity of finding solutions to difficult problems, such as partial differential equations, as well as explain which method may be easier.

## RESEARCH ISSUES IN GRAPH THEORY

Author: Tanya Henneman  
Institution: Spelman College (Bryn Mawr-Spelman Summer Math Program)  
Department: Mathematics

The purpose of this research is to explore research issues in Graph Theory using the software package Mathematica. One issue deals with observing the Hamiltonian Cycle of a graph. A Hamiltonian Cycle visits every vertex of a graph exactly once. A program was developed using Mathematica to animate and color the Hamiltonian Cycle of a graph.

This research also includes using Heuristics to minimize the total edge length of a graph with a circular embedding.

## RABIES SURVEILLANCE IN THE UNITED STATES, 1992

Author: CDC Staff and Urhonda Hines  
Institution: Morris Brown College  
Department: Mathematics

The purpose of the study was to present and analyze the 1991 Annual Surveillance report on rabies. The key issues examined were the increase or decrease in the incidence of rabies, the reasons for the change, if any and the classification of the major vectors of rabies.

Some of the findings were:

- There was an increase of about 43% in the number of cases in 1991 over the 1990 figures.
- The continued spread of raccoon rabies accounted for a significant increase in the mid-Atlantic and Northern States.
- Ninety-one percent of the animal cases were from wild animals and only about 9% were from domestic animals.
- Rhode Island was the only state that reported no case of rabies in 1991 .

## SYNTHESIS AND REACTIONS OF SULFONATED ALLENES

Author: Augusto Rodriguez, Xiaoheng Wang, Andrea Y. Hollis, Dexter Johnson and Veronica Taylor  
Institution: Clark Atlanta University  
Department: Chemistry

The discovery of potent anticancer agents containing allene, alkene and alkyne functionality has stimulated an intense effort in the synthesis of molecules with these structural features. We are interested in the synthesis and chemistry of sulfonated and phosphine oxide allenes since these types of compounds have been reported to have high biological activity. We have developed a new method for the generation of sulfonated allenes. Our procedure employs radical addition (sulfur and oxygen radicals) reaction to prepare sulfonated propargylic carbinols from unsaturated hydrocarbons. Propargylic carbinols can be easily converted to sulfonated allenes via sigmatropic rearrangement reactions. In this fashion, disulfonated allenes are obtained. In addition to outlining the synthesis of disulfonated allenes we will also discuss some interesting rearrangement reactions that these molecules undergo.



## PRODUCTION OF AQUACULTURE FEEDS FROM URBAN ORGANIC WASTES

Author: Judith Bender, Peter Phillips and Philippe Jean-Bart  
Institution: Clark Atlanta University  
Department: Biology

Seventy percent of the waste stream from Atlanta, GA is compostable material. The need for alternative ways of dealing with organic wastes is clearly indicated by the ever dwindling supply of landfill space and accelerating costs of solid waste disposal. The primary purpose of this research was to explore microbial and macro-invertebrate bioconversions of organic waste materials into high protein products, which are suitable for urban aquaculture systems. Organic solid wastes from the kitchen and yard were rapidly converted into a compost material with large populations of macro-invertebrates. This product, rich in bacteria and animal protein, was used in feeding experiments for crawfish (*Procambarus clarkii*) and tilapia fish (*Oreochromis niloticus*). Controlled laboratory experiments demonstrated that crayfish fed the compost/macro-invertebrate product (CM) showed a 152.6% weight gain, compared to a 66.7% gain of control group reared on commercial feed. Tilapia did not grow on the CM material unless it was supplemented with cyanobacteria mat. Analysis of CM showed that most of the protein was concentrated in the macro-invertebrates rather than the particulate matter. This project demonstrated good potential in the bioconversions of household and yard wastes into useful aquaculture products, thereby avoiding the high costs of disposing of these materials in the urban environment.

## MEASURING THE CONCENTRATION OF SODIUM INSIDE HAIR CELL

Author: Corliss Johnson and Nelson Y.S. Kiang  
Institution: Fisk University  
Department: Chemistry

Hair cells in the inner ear help one to hear by transducing sound energy into electrical energy. A small concentration of sodium is inside the hair cells. Loud sounds may provoke the entry of excess sodium in the hair cells, and if too much sodium gets into a hair cell, the hair cell might be damaged or die. Therefore, if one can determine the concentration of sodium in hair cells, one may be better able to understand some types of hearing loss. A fluorescent dye, sodium binding benzofuran isophthalate (SBFI) can be used to measure sodium concentrations. Known concentrations of sodium were mixed with SBFI in solution, the solutions were illuminated at 334 and 360nm, and the ratio of fluorescence emissions were used to generate a calibration curve. The ester form of the dye was administered to the hair cells; after entry the ester was hydrolyzed to the sodium sensitive form. Our data shows that the fluorescent properties of the dye inside the cell were different from the dye's properties in free solution. Reasons for the difference and prospects for further study will be discussed.

## MATHEMATICAL FOUNDATIONS OF IMAGE GEOMETRY

Author: Michelle L. Jones, Ross Whitacker, James M. Coggins  
Institution: Spelman College  
Department: Mathematics

Computer vision is a relatively new concept that has many applications. In order to further the study of computer vision in a meaningful manner, a unified mathematical foundation must be formulated. Through the use of linear algebra and a form of differential geometry developed at the University of North Carolina at Chapel Hill and in Europe a mathematical basis has been developed. These mathematical concepts describe the characteristics of surfaces thereby providing a better understanding of the content of a particular image.

## THE EIGENVALUE MOMENT METHOD: APPLICATION TO IMPORTANT ONE DIMENSIONAL SYSTEMS

Author: Jamie Joshua, Carlos Handy, Henry Hayes, Dawn Stephens,  
and Sonja Summerour\*  
Institution: Morehouse College, Clark Atlanta University, and Spelman  
College  
Department: Physics

We investigate the application of the Eigenvalue Moment Method (EMM) to various important one dimensional Schrodinger problems. Of particular interest are radial potentials including the effects of the centrifugal angular momentum barrier term. Until now, these kinds of problems have not been analyzed through the EMM theory. Also, we investigate the effective, one dimensional Coulomb potential,  $V(x) = -Z/|x|$ , so as to better understand the two dimensional quadratic Zeeman effect, for super strong magnetic fields, previously studied by Handy et al (Phys. Rev. Lett. 60, 253 (1988)).

This research is partially funded by the National Science Foundation (MRCE/CTSPS) to Clark Atlanta University.

**FUNCTIONALIZATION OF POLY-DIMETHYL SILOXANES V.I.A.  
ISONITRILE INSERTION AND 1, 2-SILYL SHIFT  
ON ZIRCONIUM**

Author: Michael E. Silver\*, Arun Kori and Kate Gingras\*  
Institution: Clark Atlanta University  
Department: Chemistry

The goal of our project is to functionalize small cyclic siloxanes and then use them as feedstock to yield functionalized Poly-Dimethyl Siloxanes (PDMS). PDMS currently find wide usage as surfactants and lubricants. We are attempting to convert siloxane methyl groups to ene-amines using Organo-Zirconium reagents. This would involve isonitrile insertion into the Zirconium-Carbon bond of a deprotonated siloxane, followed by a 1, 2-silyl Shift. Our research is directed at elucidating the requirements necessary for inducing a 1, 2-Silyl Shift. To date, we have made several attempts at inducing the shift using various zirconocene compounds but have been unsuccessful in doing so. We hope to succeed in including the shift by using our bis and tris trimethyl silyl ligands.

\*\*This work was carried out as a participant of the NSF R.E.U. program at Hope College in Holland, MI.

\*Hope College.

## **SAMPLE PRE-TREATMENT TECHNIQUES FOR URANIUM ANALYSIS IN SOILS**

Author: Richard D. Foust, Richard Robinson, Adam Lederer-Cano and  
Maeuneka C. Wero  
Institution: Northern Arizona University  
Department: Chemistry

Nationwide, the number of inorganic samples analyzed for the on-going environmental restoration of contaminated waste sites is increasing, as is the amount of time and money involved for analyses of these samples.

One important aspect of Environmental Restoration is the analyses of Uranium 235 and 238 in both soil and water samples. The purpose of this project was to compare and analyze Hot Plate and Microwave digestion techniques based on percent recovery of Uranium isotopes 235 and 238. The methodology of this project involved using Certified Reference Materials and the Inductively Coupled Plasma - Mass Spectrometer (ICP-MS) to detect Uranium 235 and 238 in soil samples. It is first necessary to liberate the Uranium from the sample matrix, and this is most often accomplished by acid digestion. Hot Plate and Microwave dissolution techniques are often used, followed by an Ion-Exchange Column (UETVA-Column), which improves Uranium recovery in Certified Reference Materials.

Results conclude that Uranium isotopes 235 and 238 in the presence of Hydrofluoric Acid were being eluted from the column, thus resulting in less than acceptable percent recovery on the ICP-MS instrument.

## STUDIES OF NEUTRON DETECTION SYSTEMS FOR THE SUPERCONDUCTING SUPERCOLLIDER

Author: Kojo Linder and Louis Osbourne\*  
Institution: Clark Atlanta University and Massachusetts Institute of  
Technology  
Department: Physics

The detection of muons is an important endeavor at the Superconducting Supercollider (SSC). The limited streamer drift tube (LSDT) system may be used in the SSC to detect muons because of its large pulses and limited noise interference. A calorimeter will also be used to detect and measure hadronic particle energies. We measured the sensitivity of the LSDT to neutrons with a Cf neutron source. A simulated spectrum of neutrons was obtained from 40 cm radius sphere of B-Poly with a Cf source. We compared this to a spectrum expected by the calorimeter used in the SSC. Both spectra appeared to be similar even though the sources were different. We concluded that our Cf test was a good measure of backgrounds expected at the SSC. Cathode tubes were also compared. We observed that Carbon coated aluminum provided excellent coating; the reason is unknown. Results will be presented and discussed.

This research is partially funded by the National Science Foundation (MRCE/CTSPS) to Clark Atlanta University.

**THE EFFECTS OF ALUM DILUENT PROCESSING PARAMETERS  
AND CULTURE MEDIA ON pH STABILITY AND PRODUCT  
CONSISTENCY**

Author: Marcia Y. Lockett\* and G. Somasekhar<sup>a</sup>  
Institutions: Spelman College\* and Merck & Company, Inc., West Point,  
PA<sup>a</sup>  
Department: Biology

Alum diluent is an adjuvant used to enhance the antigenic effect of several vaccines. Recently, there have been problems maintaining the pH of the alum diluent within the range of 5.5 to 7.0. If the pH drifts below 5.5, the vaccine could possibly lose some of its antigenic effect. Several factors in the method used to manufacture the alum diluent were compared to determine which factor(s) will produce an alum diluent with a stable pH. These factors included: the use of borate in the washing steps, rate of sodium hydroxide addition, rate of agitation, and temperature. The alum diluents were analyzed using the following assays: pH monitoring, Laser Light Scattering, Inductively Coupled Plasma - Atomic Emission Spectroscopy to determine ion concentrations, and Rate of Acid Neutralization. It has been demonstrated that when borate is used in the final resuspension the pH of alum diluent is slightly higher. The secondary particle size was found to be in the normal range for all alum diluents. Alum diluent prepared with a fast rate of agitation and rapid NaOH addition had smaller primary particles and therefore may result in alum diluent with more binding capacity for the vaccine. The alum diluents had the standard concentration of aluminum, however the borate concentration was increased in several of the alum diluents.



## **BIOLOGICAL PROCESS OPTIMIZATION: PILOT-SCALE SOIL COLUMN STUDY**

Author: Chukwu Onu, Barbara Lynch  
Institution: Southern University, Baton Rouge  
Department: Mechanical Engineering

The objective of this study was to provide data to confirm that carbon tetrachloride ( $\text{CCl}_4$ ) is degradable by the microorganisms present in Hanford aquifer soil. The history surrounding 40 years of operations at the U.S. Department of Energy's (DOE) Hanford Site involves the discharge of liquid waste contaminants such as  $\text{CCl}_4$  in land disposal areas throughout the site. However, present policy prohibits the disposal of contaminated waste directly to the environment, and remediation of existing contaminated areas may be required. Previous studies from Pacific Northwest Laboratories (PNL) indicate that microorganisms in the Hanford aquifer soil can be enhanced to degrade  $\text{CCl}_4$  in situ. The present soil column study was designed to confirm earlier work. The experimental plan involved system startup, stimulation of biomass, and destruction of  $\text{CCl}_4$ . System startup involved checking and determining basic hydraulic characteristics of the soil, including the introduction of nutrients to stimulate bacterial growth. The stimulation of biomass demonstrates that biomass can be grown in columns with sufficient microbial activity for use in  $\text{CCl}_4$  destruction. The destruction of  $\text{CCl}_4$ , the final stage of testing, begins when nutrients are added according to strategies developed from preliminary tests and the system monitored for  $\text{CCl}_4$  destruction and nutrient utilization.

## HAZARDOUS AND NONHAZARDOUS WASTE STREAM DATABASE

Author: Cassandra Mack  
Institution: Southern University and A&M College, Baton Rouge  
Department: Chemistry

A database was requested by the Environmental Health and Safety Division of Lawrence Berkeley Laboratory (LBL) because of the tremendous amount of waste produced at LBL, the mounting concerns for the environment, and a need to rapidly determine when capacity was being approached or when problems occurred. This database is to serve in many capacities. The database will aid in projecting the amount of hazardous waste that will be produced in succeeding years; it will serve as a model for other waste tracking databases, i.e., radioactive waste and/or mixed waste. This database will aid in implementing waste minimization policies and completing State and Federal Regulatory compliance reports. The database contains various information on waste produced, contained, and shipped at LBL's Hazardous Waste Handling Facility (HWHF) during the year of 1991. The information used to develop the database was obtained by visits to the HWHF and through the use of hazardous waste requisitions obtained from each hazardous waste generator. On-site visits and interviews were also conducted with a number of hazardous waste generators.

**FUNCTIONAL ANALYSIS OF THE PERIODIC  
CYSTENINE RESIDUES IN PARAMECIUM VARIABLE  
SURFACE PROTEINS**

Author: C. Leeck, J. D. Forney and Kenya Marcus  
Institution: Alabama State University  
Department: Biochemistry

The surface of each Paramecium is covered with an abundant, high molecular weight (250-300 kD) protein. A single cell line can express several different surface proteins of unknown function. Only one of these surface proteins is expressed at any one time, with expression being determined by different environmental factors such as food, PH, and temperature. Of the surface protein genes from *P. tetraurelia* stock 51, A, B, C, D, and H have been cloned and characterized. All of the surface proteins are rich in cysteine, serine, and threonine; and have a highly periodic structure. Specifically, the A gene shows a pattern of cysteine residues have been arranged in 37 periods. (This pattern of cysteine residues has also been identified in the C gene.) This research project was designed to test the importance of these cysteine periods for the expression of the A gene. A specific cysteine residue was changed to serine using site-directed mutagenesis. The mutant gene will be transformed into an A minus cell line, and expression of the A surface protein will be examined. This research was supported by NIH Grant GM08167, Alabama State University.

## **MICROBIOLOGICAL WATER QUALITY ASSESSMENT OF SPRINGS ON THE HOPI RESERVATION**

Author: Lorencita Martin, Diane Scantlebury, Harold K. Speidel  
Institution: Northern Arizona University  
Department: Biology (Microbiology)

Testing is being carried out on the Hopi reservation for the first time to examine the quality of the springs which the Hopi people currently use as drinking water or for agricultural purposes. Also, because several springs are close to waste water lagoons, they may be subject to contamination by these discharges.

Samples from twelve springs were collected each quarter, to test for the number of fecal coliform and fecal streptococci present. The Membrane Filter technique was used as the presumptive test. It is an extremely useful way to monitor drinking water because it is highly reproducible and a relatively large amount of volume can be tested at once. Subsequent series of confirming tests are also performed to verify the presence of fecal coliform and fecal streptococci. The United States Environmental Protection Agency (EPA) sets standards for drinking water based on the number of coliform microorganisms allowable per 100 ml of finished water. Fecal streptococci may be used as an indication of the source of the pollution (human or animal).

Currently, six out of the twelve springs have indicated numerous fecal coliforms and fecal streptococci while a few other springs have shown inconsistent positive results.

## DINOSAUR EXTINCTION AS A GLOBAL CLIMATE CHANGE INDICATOR

Author: Edward A. Martinez  
Institution: New Mexico Highlands University  
Department: Environmental Science

Hominids are presently concerned about the possible disruption of the present climate as the result of the introduction of large amounts of anthropogenically generated greenhouse gases into the atmosphere. The principal problem that is addressed by the proposed research is the determination of the effects on hominids and other organisms of the long term cooling event that began in the Cretaceous, that currently affects us, and which will potentially determine the fate of organisms well into the future. The immediate purpose of the research is to look for changes either in the composition or the structure of the bones of dinosaurs that might have been caused by climatic change and which could have resulted in the extinction of these organisms. Dinosaur and fossil plant material collected from the Fruitland Formation and the Kirtland Shale of the San Juan Basin, New Mexico will be examined in order to determine if global climate change played a significant role in the extinction of the dinosaurs. The specimens will be studied by using an energy X-ray spectrometer mounted on an electron scanning microscope, gas chromatograph, and differential thermal analysis, infrared and atomic absorption instrumentation.

## **SILICON-ACETYLENE POLYMERS AS PRECURSORS TO CONTINUOUS SILICON CARBIDE FIBERS**

Author: Lebone Moeti and Victorine McDonald  
Institution: Clark Atlanta University  
Department: Graduate Chemistry

Silicon-acetylene polymers synthesized by researchers at the Department of Energy (DOE) laboratory at Iowa State University (ISU) are being examined as starting materials that can be processed to yield continuous silicon carbide fibers. The objective of this research is to identify the appropriate chemistry and structure required in these novel silicon-acetylene polymers to form silicon carbide precursor fibers. For example, the effect of pendant groups and the chain length on the properties and processability of the precursor polymers is being investigated in collaboration with researchers at the DOE laboratory at ISU.

It is anticipated that results obtained during the initial activities of this research will lead to polymeric precursors suitable for conducting studies on spinnability requirements necessary to obtain continuous precursor fibers (e.g., effects of shear rate, viscosity, temperature, etc.). The pyrolysis of the silicon-acetylene polymers to form the ceramic fiber and the sintering behavior to form dense final continuous ceramic fibers will also be investigated.

**ISOLATION OF METAL-SEQUESTERING EXTRA-CELLULAR  
POLYSACCHARIDE FLOCCULENTS FROM CYANOBACTERIA  
MATS**

Authors: Crystal Moffett, Udoudo Ekanemesang, Susana Rodriquez-Eaton, Judith Bender and Lycurgus Muldrow  
Institution: Clark Atlanta University  
Department: Biological Sciences

Mixed microbial mats, dominated by cyanobacteria (*Oscillatoria sp*) have been shown to effectively remove heavy metals from contaminated water. It has been proposed that one of the mechanisms of metal sequester involves secretion of extracellular flocculents which bind and subsequently precipitate heavy metals from solution. The objective of this research is to investigate the nature of bioflocculents produced by cyanobacteria mats. Results show that a mixture of negatively-charged polysaccharides are released by the mats. These bioflocculents are heterogeneous with respect to molecular size and charge density. Flocculent production is significantly increased by the presence of heavy metals in the growth medium. Flocculent activity was detected by alcain blue binding assay. The sub-population of exopolysaccharides which show highest flocculating activity had molecular weights greater than 200,000 daltons and a uronic acid content of more than 25% of total glycosyl residues. It is suggested that uronic acids may play a role in metal binding by cyanobacteria polysaccharide flocculents.

## AN INVESTIGATION OF LAMINAR FLOW INSIDE A HELICOIDAL PIPE

Author: Ivan Muguercia and Beatrice Cazan  
Institution: Florida International University  
Department: Mechanical Engineering

An experimental study has been carried out to investigate fully developed laminar Newtonian fluid flow inside a helicoidal pipe by using the Laser Doppler Anemometer (LDA). The curvature ratio of the centerline of the coil diameter to pipe diameter,  $D_c/d$ , and the pitch ratio of the centerline of the coil diameter to the pitch of the coil,  $D_c/d$ , are 13.6 and 4.0, respectively. The axial velocity distributions at two different cross-sections of a helicoidal pipe for different Reynolds numbers (1,800, 2,500 and 4,300, corresponding to Dean numbers, 480, 700 and 1,100, respectively) are reported. The pressure drop between the entrance and the exit of the helicoidal pipe was measured. The friction factor for the helicoidal pipe is also reported in the present paper. In addition, the experimental uncertainties are evaluated for the experimental system. The uncertainties of velocity, the friction factor, the Reynolds number, and the Dean number are under 1.52%, 3.41%, 2.37% and 2.60%, respectively. It is found that the flow remains laminar until  $Re \approx 8,000$ , which is much higher than the critical Reynolds number for the straight pipe ( $Re_{cr} \approx 2,500$ ). It is observed that the fully developed axial velocity profile shifts toward the outer wall of the helicoidal pipe. In a particular region, a characteristic double peak appears. From the experimental results, it is concluded that for a high Dean number, the torsion effect is minimal compared to the curvature effect.



**A LEAD PROJECT:  
IDENTIFICATION OF HIGH-RISK AREAS IN  
NORTHWEST ATLANTA**

Author: Vivian Steadman, Elaine Barnes and Melanie Nicks  
Institution: Texas Southern University  
Department: Environmental Health

This research project entailed the following:

Soil samples were collected and evaluated around the three lead-emitting sources.

A report on the findings on the levels of lead in soil contaminated by three lead-releasing stationary sources and on the relative contributions of these sources and of the other sources (primarily paint) to this lead contamination was completed.

Children living near these stationary sources who should have their blood lead levels tested were identified.

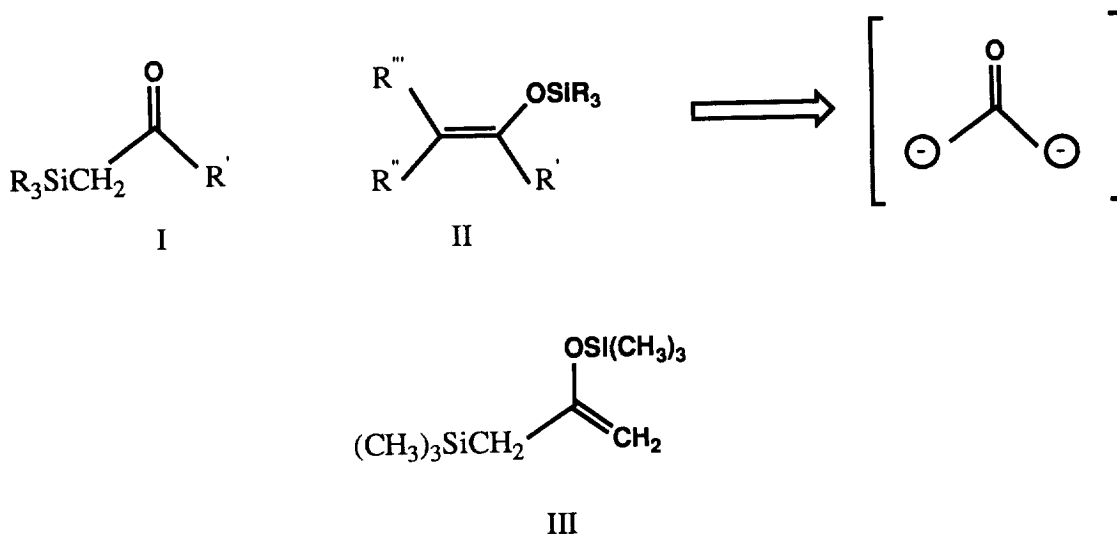
Door-to-door lead exposure surveys were implemented in the neighborhoods surrounding each lead-releasing stationary source.

Fact sheets about lead poisoning were distributed to the parents of children in the at risk areas for lead contamination. The fact sheets included recommendations on how to obtain blood tests and medical assistance for the children.

# SYNTHESIS OF 2-TRIMETHYLSILYLOXI-3-TRIMETHYLSILYLPROPENE: AN $\alpha,\alpha'$ -BIENOLATE SYNTHON

Author: Juan Suárez, Sharon Ortiz-Velázquez  
 Institution: University of Puerto Rico, Humacao  
 Department: Chemistry

The chemistry of  $\alpha$ -silylketones I in the presence of Lewis Acids compares similarly with that of the silyl enol ethers II. In our search for a model molecule that can combine both functionalities and could act as a synthon for an  $\alpha,\alpha'$ -bisenolate, we propose the compound 2-Trimethylsilyloxi-3-trimethylsilylpropene III. The synthesis of compound III is accomplished through the Grignard Reagent of chloromethyltrimethylsilane.



## **PREDICTING SAMPLE ACTIVITIES FOR NEUTRON ACTIVATION EXPERIMENTS**

Author: Stephen C. McGuire and Bonique D. Pillot  
Institution: Southern University and A&M College, Baton Rouge  
Department: Physics

Neutron activation analysis (NAA) is a technique for determining the trace element content of a wide variety of materials. Successful thermal neutron activation experiments depend on making reliable estimates of the activities induced in the sample. Specifically, this information is important for the safe handling of exposed materials as well as the effective utilization of laboratory equipment resources in performing a measurement.

The objective of this project was to apply NAA theory to the prediction of activities produced in small, solid samples of semiconductor materials irradiated in the reflector of the Ward Laboratory TRIGA reactor. For this purpose, a computer program and data base containing information on 38 elements of interest to semiconductor technology were developed. The program, written in FORTRAN, was used to calculate the time-dependent buildup and decay of activities for element masses, neutron fluxes, and exposure times specified by the researcher. When the predicted activities were combined with photon detection efficiency curves, good agreement with observed photon count rates was obtained.

## DEVELOPMENT OF EXPERT SYSTEMS

Author: Shawn L. Pullum  
Institution: Southern University and A & M College, Baton Rouge  
Department: Computer Science

The Waste Management Division (WMD) at the U.S. DOE Oakridge Y-12 facility wanted an Office Guide to perform a variety of tasks. In general, the system needed to provide instructions for office management, samples of common paperwork, and where possible, allow access to programs to fill out forms and prepare correspondence. After choosing a software platform to work in, it became a race against time to see how much of the system could be implemented in the ten weeks that were available. I was able to develop an 80% complete system which met all of the expectations that WMD put forth from the outset of my involvement with the project. The system breaks down the WMD administrative office into 19 general categories, and under each category, specific subtopics are discussed in detail. Scanned PCX images, ASCII text files, and external DOS programs are all incorporated into this system, and are working in concert to meet the expectations of the WMD Administrative Support Team.

## **EFFECT OF pH ON THE DEGRADATION OF CONTAMINANTS IN SOIL BY MICROBES**

Author: Chukwu Onu and LaSandra Robinson  
Institution: Southern University and A&M College, Baton Rouge  
Department: Biology and Center for Energy and Environmental Studies

Certain microbes at the U.S. Department of Energy's Hanford site are capable of "eating" or slowing the spread of toxic contaminants in the site's groundwater and soil. One factor affecting the growth of these microbes is pH. Recently, a study monitoring the effects of pH on the growth of microbes native to the Hanford site was conducted in simulated groundwater/media (SGM). The major objective was to identify an appropriate buffering system whose buffering capacity would resist pH changes during degradation. Tests were conducted with TRIS and potassium dihydrogen phosphate buffers. TRIS was found to have a better buffering capacity and was subsequently used in the pH adjustments of the simulated groundwater/media (SGM). Maximum growth was observed at pH 6.5, with some growth evident through pH 7.5. A drastic decline in growth was seen at pH levels beyond pH 7.5.

**CHARACTERIZATION OF THE EFFECTS OF ETCHING  
AT CdTe SURFACES BY X-RAY PHOTOELECTRON  
SPECTROSCOPY AND ATOMIC FORCE MICROSCOPY**

Author: M.A. George, H. N. Jayatirtha, L. Salary, et al.  
Institution: Fisk University  
Department: Physics and Mathematics

In this study, we examine the effects of B-methanol etching of surfaces of undoped and Cl doped CdTe single crystals. X-ray photoelectron spectroscopy (XPS) was used to characterize the nature of the chemical composition of the surface and the modifications in surface chemistry resulting from etching. Variations were observed in the O1s, Te3d and Cd3d peaks that indicate the formation of an oxide of tellurium and the depletion of surface cadmium concentrations upon etching. High resolution images of these surfaces, obtained by atomic force microscopy (AFM), showed that cleaved CdTe were atomically flat while the polished samples appeared to be amorphous. Etching the freshly cleaved samples revealed the formation of prismatic features. Evidence of AFM induced modifications of freshly etched samples was also observed and a possible mechanism of interaction will be presented.

## A NEW ASSAY FOR DETERMINING L-ASAPRAGINASE ACTIVITY

Author: Tressa Scineaux\* and P. DeHaven<sup>a</sup>  
Institutions: Spelman College\* and Merck & Company, Inc., West Point,  
PA<sup>a</sup>  
Department: Biology

Drug X is a chemotherapeutic agent administered to children with leukemia in order to reduce the asparagine concentration. Asparagine appears to be an essential amino acid in these tumor cells. Drug X contains the enzyme asparaginase amidohydrolase derived from *Escherichia coli*. Asparaginase is an enzyme which catalyzes the hydrolysis of asparagine to aspartate, ultimately reducing the asparagine concentration available for tumor growth.

The purpose of my project was to investigate a new assay which measured asparaginase potency. The instrumentation used for the assay was the Beckman DU spectrophotometer. The kinetics/time method within the spectrophotometer was used to determine asparaginase activity. These kinetic experiments were performed to test the limits of the assay. In addition, the ideal conditions for optimum activity were observed. These conditions included pH and range of concentration. Ultimately, the automation of the assay was explored.

Through my efforts the following aspects were established: the linearity of asparaginase activity, the reproducibility of data and the ruggedness of the assay. Implementation of this new assay would facilitate the release of Drug X and accelerate production. The new assay was simple to perform, environmentally safe, produced consistent results and was very sensitive.

## **SILICONE BREAST IMPLANTS WITH THE APPLICATION OF FINITE ELEMENT ANALYSIS**

Author: Robyn Michelle Scott  
Institution: Morris Brown College  
Department: Mathematics

In the study, a new software, COSMOS/M Finite Element Analysis, was used to examine the complications of Silicone Breast Implants. The reliability of the polyurethane sac was determined by various tests used in FEA.

The well-known Diacon silicone implant was discontinued in the U.S. because of leakage which resulted in a series of health problems, such as deterioration of the musculatenous flaps, calcification of the breast, and cancer related symptoms.

The simulation of the silicone breast implant on COSMOS system helps engineers to solve problems of structural analysis, foreign body reactions, pressure, fluid flow, permeability and the different stress factors in the silicone.

This research reduced time and money spent in building prototypes, testing and redesigning of the implants to meet certain specifications.



## **A STUDY OF INHERENT MOISTURE AND THERMAL PROPERTIES OF COAL BY THERMOGRAVIMETRIC ANALYSIS**

Author: Fawzy Sadek and Anthony Segers  
Institution: Winston-Salem State University  
Department: Physical Sciences

The objective of this investigation was to determine the relationship between structural water and heating values in coal. The coal producer considers the heating potential to be the most significant property of coal. However, to determine this value, one must utilize many expensive and time-consuming tests. On the other hand, if the relationship between inherent moisture and heating potential were determined and a suitable formula were established to reflect this relationship, then one would need only to determine structural water and heating values would follow as predicted. The true utility lies in that structural water is quite readily determined utilizing only moderately expensive equipment and the time interval is drastically reduced.

## **A RACE AND CLASS DISTRIBUTION ANALYSIS OF COMMUNITIES SURROUNDING TRI FACILITIES IN THE STATE OF LOUISIANA**

Author: Carita T. Shanklin and William Serban  
Institution: Xavier University of Louisiana  
Department: Political Science

Recent studies indicate that there is a national pattern of locating hazardous waste facilities near minority communities. Demographic patterns have also shown that an overwhelming majority of these communities are poor.

The purpose of this study is to present a race and class distribution analysis of the census blocks and tracts surrounding TRI (Toxic Release Inventory) facilities in the state of Louisiana. Data according to race and class will be correlated as two separate and distinct entities to the locale of the TRI waste site. Using statistical methods, the tracts and blocks surrounding TRI facilities will be compared to tracts and blocks without TRI facilities in order to determine if the ethnic and socioeconomic conditions differentiate. Secondly, this research will analyze the distinction between race and class as it pertains to environmental equity. Differentiating statistics on race and class as they relate to disparate impact and/or discriminatory intent court cases will be addressed.

This study is significant because it uses detailed census block level and census tract level data. Previous studies have analyzed this information on much larger geographic scales using county or zip code areas, which often tends to disguise the important trends being examined.

## **A VISUAL-ORIENTED INTELLIGENT GRAPHIC USER INTERFACE FOR PHYSICISTS**

Author: Keithia Simpson and Olugbemiga A. Olatidoye  
Institution: Clark Atlanta University  
Department: Dual Degree: Mechanical Engineering

The focus of this paper is on the development of a Graphic-User-Interface (GUI) for Physicists. Presently, most of the available GUIs support geometric entity drawing, but they are not flexible enough to support experimental processes. The research involves how Physicists execute their problem solving skills, in the laboratory environment. The anticipated result of this investigation will be a new GUI that will assist Physicists in their problem solving and experimental scenarios, as well as simplify their instructional and tutorial tasks. The initial part of the development will entail a link between a 3D modeling design package and an object oriented programming language, C++. A simple physical system will be visually represented in the 3D package, and it's parameters will be controlled by C++ in the Windows environment.

This research is partially funded by the National Science Foundation (RIMI/CTSPS) to Clark Atlanta University.

**REDUCTION OF ENVIRONMENTAL CONTAMINANTS  
THROUGH ZIRCONIUM (IV) COMPLEXES AS COAL  
LIQUEFACTION CATALYSTS**

Author: Bobby L. Wilson, Richard Smith, and Lamont Terrell  
Institution: Texas Southern University  
Department: Chemistry

Zirconium tetrabromide ( $\text{ZrBr}_4$ ) was allowed to react with 2 molar and 4 molar ratios of potassium dihydrobis(pyrazolyl)borate,  $\text{K}[\text{H}_2\text{B}(\text{Pz})_2]$ , to produce  $\text{ZrBr}_2[\text{H}_2\text{B}(\text{Pz})_2]_2$  and  $\text{Zr}[\text{H}_2\text{B}(\text{Pz})_2]_4$ , respectively. These complexes were characterized by elemental analysis, proton NMR, and FTIR and thereby determined to be of acceptable purity.

The products were then evaluated as catalysts for direct coal liquefaction in an autoclave procedure. Results indicate that these oil-soluble catalysts are useful in making coal a more environmentally acceptable fuel.

## DEPHOSPHORYLATION OF RAT BRAIN SODIUM CHANNELS BY PHOSPHATASE

Author: S. Rossie and Stephanie E. Smith  
Institution: Alabama State University  
Department: Biochemistry

Sodium channels allow sodium ions to flow into cells during depolarization. They are regulated by phosphorylation and dephosphorylation. We attempted to determine if sodium channels are dephosphorylated *in situ* by phosphatase 2A. Rat brain synaptosomes were prepared and treated with okadaic acid to inhibit phosphatase 2A, or forskolin to stimulate cAMP formation and cAMP dependent protein kinase. Next, sodium channels were solubilized, isolated by immunoprecipitation and phosphorylated with  $^{32}\text{P}$ -ATP. Samples were then subjected to SDS-PAGE and  $^{32}\text{P}$ -labeled sodium channels were detected by autoradiography. In preliminary studies both drugs inhibited  $^{32}\text{P}$  incorporation : forskolin by stimulation phosphorylation and okadaic acid by inhibiting dephosphorylation. In subsequent studies however, we were unable to duplicate these results. Control studies are underway to evaluate the parameters of this experimental design. This research was supported by NIH Grant GM08167, Alabama State University.

**INFRARED DIFFUSE REFLECTANCE SPECTROSCOPY  
OF ORGANOPHOSPHOROUS COMPOUND  
ADSORPTION/DECOMPOSITION ON METAL OXIDES**

Authors: Vasumathi R. Chakravarthy, Wallace E. Smith, Mark B.  
Mitchell, and Eric A. Mintz  
Institution: Clark Atlanta University  
Department: Chemistry

Organophosphorous compounds constitute a major component class of such potent and environmentally hazardous compounds as insecticides and chemical warfare agents. The investigation of possible modes of decomposition of these compounds into less toxic forms is of vital importance particularly for applications such as gas masks and other toxic atmosphere air cleanup systems.

We have observed the infrared diffuse reflectance spectrum of a model organophosphorous compound, dimethyl methylphosphonate (DMMP) on a series of metal oxide surfaces. A mechanism for adsorption of DMMP on alumina which is consistent with our observations involves the electrophilic attack of surface metal atoms at the phosphoryl oxygen of the DMMP molecule. However, on dehydrated (as opposed to dehydroxylated) magnesia, our data is consistent with an interaction involving a nucleophilic attack of surface hydroxyls at the phosphorous atom of DMMP.

## **SPECTROSCOPIC MEASUREMENT OF EMISSION IN A NEODYMIUM DOPED FIBER PUMPED AT 1.064 MICRONS**

Author: Dawn Stephens, Michelle L. Stock, Lih-Mei Yang, and Herbert  
Winful\*  
Institution: Clark Atlanta University and the University of Michigan  
Department: Physics

We present the results of spectroscopic measurements on Neodymium doped silicate fiber. The phenomenon of emission in the visible (470 nm, 650 nm, and 780 nm) when pumped by 1.064  $\mu\text{m}$  occurred. Results are compared to those of an undoped silicate fiber. Possible explanation for these emissions are discussed.

In our experiment, we pumped the fiber with a modelocked Nd:Yag laser. The pulses were 100 ps in duration at a repetition rate of 76 MHz. Average power was varied between 50 mW and 3 W. Measurements were made with a monochromator using a photomultiplier tube and a photon counter. Threshold average pumping power of between 50 mW and 100 mW was required to obtain emission at 470 nm and 650 nm. However, the 780 nm emission had a threshold below 50 nW.

This research is partially funded by the National Science Foundation (MRCE/CTSPS) to Clark Atlanta University.

## VIBRATIONAL SPECTROSCOPY OF DNA/INTERCALATOR COMPLEXES

Authors: Shashi Bellam, Reba Gates, Paul Thomas, and Mark B. Mitchell  
Institution: Clark Atlanta University  
Department: Chemistry

The interactions of DNA with different anti-tumor agents is studied using a variety of analytical techniques intended to investigate the mode of binding of the drug to the DNA molecule. One of the most selective techniques is vibrational spectroscopy, which can be used to probe changes in bond strength and molecular conformation which result from the interaction. For studies carried out in aqueous solution, the solvent of choice for these systems, infrared spectroscopy has typically not been used because of the well-known strong absorbance of water in the infrared region. Resonance Raman spectroscopy has been used with great success for these investigations, but this technique is most sensitive to the drug itself, not to the DNA, so that the bond order changes and conformational changes which are observed are those associated with the drug.

We have recently obtained results using infrared spectroscopy for two drug/DNA complexes: ethidium bromide/DNA (EtBr/DNA) and copper tetramethylpyridyl porphyrin/DNA Cu(TMpy-P4). Our results show that the binding of ethidium bromide to DNA is much weaker than that of the porphyrin to DNA. The EtBr/DNA complex results in a much smaller shift of the vibrational absorptions associated with the phosphate group of the DNA than does the Cu(TMpy-P4)/DNA complex. This indicates that the coulombic interaction between the porphyrin and the DNA phosphate group is much stronger than that between ethidium and the DNA phosphate group.



**THE CATALYTIC ACTIVITY OF OXIDIZED (COMBUSTED) OIL  
SHALE TO REMOVE NITRIC OXIDE FROM COMBUSTION FLUE  
GAS STREAMS**

Author: John G. Reynolds\* and Michael Torres  
Institution: \*Lawrence Livermore National Laboratory and The University  
of Texas at El Paso  
Department: \*Chemistry/Civil Engineering

The United States has enough oil shale to supply our energy needs for centuries. An oil shale retorting process is being developed at LLNL to utilize this fuel source and to produce liquid fuel at a cost competitive to conventional oil recovery processes. During this process, retorted oil shale is combusted to provide energy and is recycled to drive the retort process. This results in nitrogen oxide emission.

Oxidized (combusted) oil shale has been found to remove nitric oxide (NO) from laboratory simulated flue gas streams when ammonia is used as the reductant. This paper discusses the factors which optimize this removal, the potential active species responsible for deNO<sub>x</sub> activity, and design parameters for removal of NO in the retort flue gas.

## GLUCONEOGENIC RATES OF DIABETIC FEMALE RATS

Author: Scott Savage, Carrie Carr, Telletha Valenski  
Institution: Northern Arizona University  
Department: Chemistry

The effect of endurance diabetic training and non-training on the gluconeogenic rate was investigated using endurance-trained female Sprague-Dawley rats. The animals were randomly assigned to trained and control (untrained) groups. After a minimum of two months training, the animals were surgically fitted with catheters in the jugular vein and carotid artery. Following a three-day recovery period, the animals were continuously infused with  $\text{NaH}^{14}\text{CO}_3$ , and  $[6\text{-}^3\text{H}]$  glucose in a 1.5M glucose intravenous infusion. Arterial blood samples were taken every 30 minutes over the two hour infusion period and analyzed for glucose and lactate concentrations. The gluconeogenic rate based on both the appearance of  $[^{14}\text{C}]$  glucose in the blood and the dilution of  $[^3\text{H}]$  glucose increased with endurance training. Non-trained changed the gluconeogenic glucose of trained animals to glycogen synthesis thereby in the blood. This explains why the gluconeogenic rate lowered in the non-trained diabetic rat.

## MICROBIAL ENHANCED OIL RECOVERY

Author: Sophia Walker  
Institution: Alabama A&M University  
Department: Zoology

This project deals with the prospects of Microbial Enhanced Oil Recovery (MEOR). Because of the costs associated with two Enhanced Oil Recovery (EOR) Techniques, such as thermal recovery and chemical treatment, more and more researchers are now studying MEOR. Consequently, nine bacterial strains were used in conjunction with two highly-viscous, high-sulfur heavy crude oil and one waste by-product oil. Biodegradation experiments were observed at 65°C and room temperatures. Agitation environments, pH extremes and low-carbon media were also measured for each sample. Hydro-carbon content drastically declined when measured on the Gas Chromatography Mass Spectrometry (GC-MS). Preliminary results show that future research developments and applications are needed.

## THE BWID PLAN AND SUPER CRITICAL WATER OXIDATION

Author: William Washington<sup>a</sup>, R. McAtee\*, C. Shapiro\*, and P. Cannon\*  
Institution: Xavier University of Louisiana<sup>a</sup> & Idaho National Engineering  
Lab Department: Chemistry Department\*

The mission of the Buried Waste Integrated Demonstration (BWID) Program is to identify, evaluate, and demonstrate treatment technologies that support remedial activities to permanently protect people and the environment from both hazardous and radioactive waste buried mainly at the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL) and at other Department of Energy Sites. My task in this program was the review and categorization of technologies recommended to the BWID program and to then compile a summarized Technology Fact Sheet from each vendor for input into a BWID database.

A second project that was worked on was the Super Critical Water Oxidation (SCWO) project, a method based on the assumption that experimental SCWO is a viable technology for the treatment of mixed waste. SCWO is the application of excess heat and pressure to water, which forms a plasma-like state where the oxidation of organic waste is more easily accomplished. My task in this project was the compilation of candidate waste information to be used by the SCWO process, a process that is also a very good example of the type of technologies presented to the BWID project.

## INTERACTION OF TOXIC METALS WITH DNA

Author: Lourdes M. Torres and Marlene Waugaman  
Institution: Clark Atlanta University  
Department: Chemistry

The critical roles of metal ions on the vital functions of living organisms is now widely recognized. Metals are essential in metabolic processes, but excessive exposure to certain species can result in severe toxicity. Many metals have been linked to acute toxicity and carcinogenicity both in animals and humans, and a number of potentially hazardous trace metals are now consistently found in the atmosphere, soil and water supplies, so that human beings are constantly exposed not only to isolated pollutants, but to a myriad of potentially toxic chemicals. Synergistic effects have been extensively documented in biological systems, but not at the molecular level, and little or no information is available on the effect of simultaneous exposure of DNA to multiple pollutants.

We are exploring the critical issue of how deleterious metal ions damage DNA at the **molecular level** by studying the effect of single and multiple metal ions on polynucleotides and DNA. We are in the process of characterizing the structural changes in DNA and polynucleotides caused by interaction with the toxic/carcinogenic metal cadmium using spectroscopic techniques. We are applying UV-visible, nuclear magnetic resonance (NMR), FT-IR and FT-Raman spectroscopies to the study of the mechanism by which interaction with cadmium affects the structure of DNA. Then we will explore the synergistic effect on DNA structure of **simultaneous exposure** to multiple toxic/mutagenic chemicals.

## PREDICTION OF THE DISPERSION EFFECTS ON THE SECOND-ORDER POLARIZABILITY OF ORGANIC MOLECULES

Author: Erica M. Whitney and Beatriz H. Cardelino  
Institution: Spelman College  
Department: Chemistry

Certain molecules, when placed in an electric field and illuminated by a light with energy less than their excitation or absorption energy, can double the energy of the incident beam. Dispersion effects on second-order polarizabilities can be determined experimentally but may also be predicted using known theories. The basis for predicting the dispersion effects of second-order polarizabilities is time dependent perturbation theory. These calculations require extensive computations. To predict dispersion effects for large organic molecules, considerable approximations must be done. The effect of laser frequency on the second-order polarizability was estimated for p-nitroaniline, aniline, and nitrobenzene with a nitro group coplanar or perpendicular to the aromatic ring. The dispersion effects were estimated for these molecules in order to estimate the quality of the approximations.

This research is partially funded by the National Science Foundation (MRCE/CTSPS) to Clark Atlanta University.

**EXPRESSION ANALYSIS OF RUBELLA CLONES, E1 FULL  
LENGTH, E1 146-437, AND CORE IN STRATAGENE EPICURAN  
TOPP™ STRAINS**

Author: G. Maine, L. Chovan, and M. Williams  
Abbott Laboratories, Abbott Park, Illinois  
Institution: Morehouse College  
Department: Biology

The Rubella proteins E1, E1 146-437, and Core can be used as markers to identify the Rubella virus. The clones E1 full length, E1 146-437, and Core do not express well in XL-Blue *E. coli* cells. Stratagene Epicurian Topp™ Strains are known to overexpress recombinant proteins that are difficult or impossible to express in XL-Blue *E. coli* cells. In an attempt to achieve more effective expression of the clones, Stratagene Epicurian Topp™ Strains were induced to express E1 fl, E1 146-437, and Core. After analysis of the six strains by SDS-PAGE and immunoblotting with monoclonal antibodies, it was discovered that none of the Topp™ Strains express the clones more effectively. Even the strains that do express the clones are highly truncated.

## PREPARATION OF NEW SUBSTITUTED FULVENES FOR USE IN ORGANOMETALLIC SYNTHESIS

Author: Gayla Wilson, Ollenia Holloway, Darryl Hilliard, Xiaoli Lui,  
Xiu-Ren Bu, and Eric Mintz  
Institution: Clark Atlanta University  
Department: Chemistry

6-Substituted fulvenes have been shown to be useful starting materials for the preparation of substituted cyclopentadienyl ligands, which can be utilized in organometallic synthesis. We are currently investigating the use of di- and tetramethylcyclopent-2-enones as starting materials for the preparation of ring substituted fulvenes.

We have recently developed methods to prepare 6-(hydroxyphenyl)fulvenes and 6-(hydroxyphenyl)benzofulvenes. We are currently examining the use of these difunctional fulvenes to prepare cyclopentadienyl and fluorenyl ligands which have the potential to serve as chelating ligands.

The results of recent work in our laboratories will be presented.



## OUTDOOR TESTING OF METALIZED CATALYST

Author: Mark Mehos, Craig Turchi and Adriana Ybarra  
Institution: University of Texas at El Paso  
Department: Mechanical and Industrial Engineering

Current research at the National Renewable Energy Laboratory is directed at making the solar detoxification process more economical and reducing the overall cost of the process in order to be more competitive with conventional treatment technologies. The process uses ultraviolet (UV) energy from the sun in conjunction with a photocatalyst, titanium dioxide, to decompose organic chemicals into nontoxic compounds. Improvement in the quantum efficiency of photodestruction of organics is crucial to producing a viable commercial technology. Catalyst performance offers the largest potential of improvement and thus reduction in costs.

The paper discusses the results of laboratory and small-scaled field experiments which suggest that the photocatalytic activity of Aldrich titanium dioxide for aqueous trichloroethylene (TCE) destruction can be improved through platinization. Outdoor performance tests comparing a supported platinized catalyst to a fixed unplatinized catalyst in the destruction of aqueous TCE are also discussed. The same level of performance enhancement with a fixed platinized catalyst instead of a slurry platinized catalyst means the elimination of the filtration step which will help control costs for a commercial detoxification plant.

## **ELECTROCHEMICAL STUDIES OF NICKEL IN SECONDARY BATTERY ELECTROLYTES**

Author: Kathryn Stribel and Alexandra Zippert  
Institution: Lawrence Berkeley Laboratory  
Division: Energy and Environment

Batteries are well-known for their proficiency in converting and storing electrical energy. They are used in a variety of devices presently and are being advanced for use in large-scale energy storage technologies, which could supply needed flexibility in the choice of primary fuels for generating energy.

This project involved using cyclic voltammetry and oxygen evolution to determine what electrolyte will provide optimal results for both the zinc and the air components of the battery.

The results were not very conclusive--there was no definite relationship between the current and the charge density; and the rotation dependence wasn't clear.

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## **APPENDIX 6**

**"A Forum on Undergraduate Research  
Experiences of Minority Science, Mathematics and  
Engineering Students and A Workshop on  
Graduate School Opportunities"**

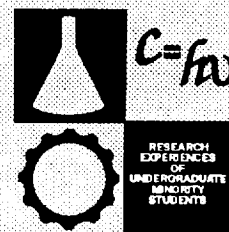
***Abstracts of Student Poster Presentations***

***Supplement***



**A Forum on  
Undergraduate Research  
Experiences of  
Minority Science,  
Mathematics and  
Engineering Students and  
A Workshop on Graduate  
School Opportunities**

**October 15 - 17, 1992  
Georgia World Congress Center  
Atlanta, Georgia**



# **ABSTRACTS OF STUDENT POSTER PRESENTATIONS SUPPLEMENT**

## **SPONSORS**

**The Historically Black Colleges and Universities/Minority Institutions  
Environmental Technology and Waste Management Consortium  
(The HBCU/MI Consortium)**

**The Massachusetts Institute of Technology**

**The Center for Non-Linear Analysis at Hampton University**

**U.S. Department of Energy (DOE)**

**U.S. Environmental Protection Agency (EPA)**

**U.S. Army**

**National Aeronautics and Space Administration (NASA)**



**ANALYSIS OF THE ANTIGEN RECEPTORS EXPRESSED BY  $\gamma\delta$ T-  
LYMPHOCYTES IN INFLUENZA VIRUS-INFECTED MICE**

Author: Lorrie Ann Armfield  
Institution: University of Maryland Eastern Shore  
Department: Natural Sciences

T-lymphocytes are one of the major cells of the immune system. They function to recognize antigens expressed by pathogens and to mobilize immune responses against them. Recognition of foreign antigens is mediated by antigen-specific receptors expressed on the surface of T cells. The aim of my internship this summer was to define the structure of the  $\gamma\delta$ T-cell receptors expressed by  $\gamma\delta$ T-cells involved in the immune response to influenza virus. In order to determine both the  $\gamma$  and  $\delta$  chain expression, I found it necessary to not only isolate RNA and synthesize cDNA, but to also conduct polymerase chain reaction assays. These procedures served as prerequisites for understanding the function of  $\gamma$  and  $\delta$ T cells in an immune response *in vivo*.





**THE WASTE ISOLATION PILOT PLANT (WIPP) PERFORMANCE  
ASSESSMENT GEOSTATISTICS TEST PROBLEM**

Author: Vardry E. Austin

Institution: North Carolina A&T State University

Department: Civil Engineering

The WIPP is located East of Carlsbad, New Mexico. The site, now being used for research and development by the United States Department of Energy (DOE), is designed to be the first geologic repository to safely dispose of transuranic (TRU) wastes.

The appropriateness of the site will depend upon the application of proposed solution methods to the WIPP performance assessment (PA) problem. Since there is risk involved in PA calculations, sensitivity and uncertainty analysis are applied to help determine the feasibility of proposed solution methods.

The geostatistics test problem, used in lieu with sensitivity and uncertainty analysis, has three goals: 1) to determine whether particular inverse methods are inappropriate for applications to the WIPP problem; 2) identify those techniques which are particularly well suited for application to the types of features which exist at the WIPP; and 3) demonstrate defensibility of the final WIPP performance assessment calculations. However, the final WIPP PA calculations have not yet been produced, because the required solution method(s) to the WIPP has/have not yet been developed.



## MUTATION TESTING USING FOUR-STATE FINITE AUTOMATA

Author: Belinda Banks, Renee Basnight, Willie Basnight, Cory Cooper, Alisha Hart, Deborah Jones and Stephanie Vaughan

Institution: Elizabeth City State University

Department: Department of Mathematics

The purpose of this research was to identify the test data sets which killed the most mutants from the original machine.

A mutant is a program that differs from the original program by a few simple errors. We used four-state finite automata to utilize the theory of mutation testing. We formed our original machine from the first, middle, and last initial of our names. The ASCII values of our initials were converted into binary. We dropped the first two bits, leaving a twenty-two bit number. To create single mutants we can change the start state, add or delete a final state, or change an entry in the transition table. The accepting strings of the mutants were compared to the accepting string of the original machine. If the strings are alike then the mutant is equivalent to the original machine. If not, then you would have to find the shortest string to kill the mutant.



## THE CAMERA AND THE HUMAN EYE

Author: Dr. Ralph W. Turner/Mrs. Dedra B. Azonobi, Kendall  
Campbell  
Institution: Florida A&M University  
Department: Chemistry

It would seem that the human eye and camera are very similar devices, consisting of light sensitive materials and lens; however, the differences between the two are much greater than the similarities.

The major difference between the two systems is the existence of a scanning system for visual perception of a scene by the eye/brain combination. A high level of resolving power and color discrimination exists only at the small fovea where the visual axis intersects the retina. A complete perception of the scene is built up by a series of small irregular movements of the eye, called saccade, to cover the region of interest by integration of the small, sharp images. The conventional camera does not use such a scanning system at all, although other systems such as television cameras and infra-red imaging devices employ a regular line scanning method for obtaining images.



## **SAMPLE PRE-TREATMENT TECHNIQUES FOR URANIUM ANALYSIS IN SOILS**

Author: Richard D. Foust, Richard Robinson, Adam Lederer-Cano and  
Maeuneka C. Wero  
Institution: Northern Arizona University  
Department Chemistry

Nationwide, the number of inorganic samples analyzed as part of the on-going environmental restoration of contaminated waste sites is increasing, as is the amount of time and money involved in these analyses.

One important aspect of Environmental Restoration is the analyses of Uranium 235 and 238 in both soil and water samples. The purpose of this project was to compare and analyze Hot Plate and Microwave digestion techniques based on percent recovery of Uranium isotopes 235 and 238. The methodology of this project involved using Certified Reference Materials and the Inductively Coupled Plasma - Mass Spectrometer (ICP-MS) to detect Uranium 235 and 238 in soil samples. It was first necessary to liberate the Uranium from the sample matrix, and this is most often accomplished by acid digestion. Hot Plate and Microwave dissolution techniques are often used, followed by an Ion-Exchange Column (UETVA-Column), which improves Uranium recovery in Certified Reference Materials.

Results conclude that Uranium isotopes 235 and 238 in the presence of Hydrofluoric Acid were being eluted from the column, thus resulting in less than acceptable percent recovery on the ICP-MS instrument.





## A COMPARATIVE STUDY OF THE ATTACHMENT OF MARINE BACTERIA TO POLYSTYRENE SURFACES

Author: Dhayalini Chandrasegaram and J.B. Stukes

Institution: South Carolina State University

Department: Department of Natural Sciences

The purpose of this study is to understand and control the molecular processes which determine the sequence of interactions among substrata, bacteria, and invertebrate larvae in marine environments. One of the areas of study deals with the attachment of marine bacteria to polystyrene surfaces. In this study, three different species of marine bacteria *Deleya marina*, *Alteromonas macleodii*, and *Pseudomonas fluorescens* were introduced to the polystyrene cuvettes. Cells were exposed to the cuvettes at different time interval. Unattached cells were removed by rinsing the cuvettes with distilled water. The cuvettes were then fixed using Bouin's fixative and stained using crystal violet. The spectrophotometer was used to measure the attachment of the cells at 590 nm. *Deleya marina* and *Pseudomonas fluorescens*, the cells showed maximum attachment at two hours followed by a decline in attachment. In contrast, *Alteromonas macleodii* exhibited a high initial attachment at 15 minutes and remained constant until 2 hours. *Alteromonas macleodii* attaches more readily to the polystyrene surface than *Deleya marina* or *Pseudomonas fluorescens* under the same conditions. Current experimentation deals with exposing the cuvettes to bacterial supernatant prior to the introduction of bacterial cells to study its effect on attachment.



## THE EFFECTS OF 16, 16-DIMETHYL-PROSTAGLANDIN E<sub>A</sub> ON HUMAN INTESTINAL COLON CELLS.

Author: Michael A. Davis and Charles Rhyme Ph.D.

Institution: Jackson State University and University of Missouri, Columbia

Department: Department of Biology

16, 16-Dimethyl-prostaglandin E<sub>2</sub> (dmPGE ) is known to protect the stomach epithelium from noxious irritants such as alcohol or aspirin, and to accelerate ulcer healing. In this study, we used the N<sub>2</sub> goblet cell line to investigate the effect of dmPGE on the secretion of mucus, the growth response, and its protection against irritants. To assay secretion, a monolayer of cells was exposed to various concentrations of dmPGE. The highest secretory stimulation was achieved at 100  $\mu$ M/ml, while there was no increased mucus secretion at 1  $\mu$ M/ml or 10  $\mu$ M/ml. To determine if dmPGE had any effect on the growth, cells were grown in 0, 0.1, 1, and 10  $\mu$ M for 10 days. After counting during alternating days, it was determined that dmPGE did not increase the cell proliferation rate. To evaluate cell injury and the presence of protection, a model irritant (ethanol) was used. It was determined that dmPGE did not protect proliferating (non-mucus producing) N<sub>2</sub> cells. Experiments testing well differentiated mucus-producing N<sub>2</sub> cells are underway. This work was conducted at the University of Missouri, Columbia.



**ESTERIFICATION OF 20-CARBON FATTY ACIDS INTO PHOSPHOLIPID  
AND NEUTRAL LIPID FRACTIONS OF DIFFERENT CELL LINES**

Author: Karen L. Felton  
Institution: Elizabeth City State University  
Hampton University  
Department: Chemistry

The purpose of this project was to find the lipid fraction, that is, where fatty acids are esterified when a steady increase in concentration of fatty acids are administered into cells. Two of uptake methods, for fatty acids into cells previously used by Kinsellor's group will be discussed. One of these is highly efficient uptake method which has a short duration period of time from approximately ten minutes to one hour. As a result, we used an hour of incubation for our studies to look at the high efficiency uptake.



**UNALTERED RESISTANCE OF THE SPORES OF NON-OXIDIZING  
MUTANTS OF THE MARINE MANGANESE-OXIDIZING BACILLUS  
SPECIES STRAIN SG-1**

Author: Marcia Sharelle Jones

Institution: Jackson State University, Jackson, Mississippi

Department: UCSD/SIO/SURF, Host Institution

Manganese is an abundant metal in the marine environmental and marine bacteria play an important role in manganese cycling. Spores of the marine *Bacillus* species strain SG-1 oxidize soluble manganese (II) to manganese (IV) which precipitates as an insoluble brown metal oxide on the spore surface. In previous work, mutant strains of this bacterium were created whose spores no longer oxidize manganese. Although the mechanism of manganese oxidation is not yet known, it is suspected that a spore coat protein is involved. Since the coats normally provide resistance to external physical attack, we wished to examine what effect, if any, the inability to oxidize manganese might have on the resistance of the mutant spores.

SG-1 and its mutant strains, SG1LTM11, SG1LTM14, SG1LTM18, and SG1LTM19 were grown until nutrient exhaustion induced sporulation. Efficiency of sporulation was monitored by microscopic counts. Sporulated cultures were assayed for resistance to heat, organic solvents (ethanol and chloroform), and lysozyme by plating to determine the viable counts before and after treatment. The procedures for each assay were taken from Molecular Biological Methods for Bacillus edited by Harwood et al. (1990) and modified to suit SG-1. The data obtained suggests that the SG-1 and mutant spores are sensitive to ethanol, but no significant differences are seen in any of the treatments. This indicates that the inability of the mutants to oxidize manganese has not significantly impaired their ability to resist the physical agents tested.





## THE EFFECTS OF SALINITY ON THE FILTRATION RATE OF MODIOLUS RECTUS

Author: Fred Jenkins

Institution: University of Maryland, Eastern Shore

Department: Department of Natural Sciences

Intertidal species are well adapted to immense and frequent environmental changes (e.g. light, temperature, and salinity). This study tested the effects of salinity changes on the filtration rate of *Modiolus rectus*, a common intertidal mussel species found in the Pudget Sound region of Washington. The filtration rate of the mussel measured while being subjected to four salinity treatments of 15ppt, 20ppt, 25ppt, and 30 ppt. The results indicated that the mussel would filter only at the highest salinities (25 ppt and 30 ppt). These results may suggest why *Modiolus rectus* is located subtidally where there are no extreme salinity changes with which it would have to tolerate.



## **PURIFICATION OF EXTRACELLULAR POLYSACCHARIDE FROM BACTERIA ISOLATED FROM CHARLESTON HARBOR, SC**

Author: Leyana Lloyd and Frank Weaver

Institution: South Carolina State University

Department: Department of Natural Sciences

Using a combination of dialysis, enzyme degradation, solvent precipitation and size-exclusion chromatography, high-molecular-weight extracellular polysaccharides (EPS) were isolated from supernatants of *Pseudomonas fluorescens*. Spectrophotometric analyses of purified, lyophilized *Pseudomonas fluorescens* EPS indicated 80% carbohydrate, 19% protein, 1% gluconic acids and no DNA. Several bacterial species taken from Charleston Harbor were cultured in Zobell's marine broth (ZMB), identified, and their supernatant's EPS partially purified. In all bacterial species examined, high-molecular weight (HMW, >50,000 daltons) protein and carbohydrate concentrations were 17-34 ug/mL and 11-22 ug/mL, respectively in the original supernatant. Based on size-exclusion chromatography, *Pseudomonas fluorescens* HMW protein and carbohydrate had molecular weights of about two million daltons and comprised less than 8% and 3%, respectively, of these supernatant components.

This project is supported by the Office of Naval Research Grant Number N00014-90-J-4048.



## ISOLATION AND PURIFICATION OF pPM22 PLASMIDS

Author: Jarrell K. Holmes, Lucy A. Martin and J.B. Stukes

Institution: South Carolina State University

Department: Department of Natural Sciences

The objective of this study is to isolate pPM22 plasmid DNA from Escherichia coli cells. pPM22 is a plasmid resistant to the antibiotic ampicillin and harbors a partition mutant gene. For the isolation of this plasmid, the cells were grown in nutrient broth containing leucine, thiamine, threonine, and the antibiotic ampicillin. After the cells were incubated in a water bath overnight at 37°C, the cells were harvested via centrifugation. Subsequently, the plasmids were isolated using a modification of the procedure developed by Birboim and Doly (1979). Isolated plasmid DNA was electrophoresed through an agarose gel system. Results indicate that the plasmid has three forms (relaxed, open circular, and supercoiled). However, when the plasmid is restricted with Eco R1 restrictive enzyme, only one band is present. This is not surprising since there is only one (1) restriction site for the enzyme. Future experiments will include the ligation of the pPM22 plasmid with each of the thirteen fragments of the R6 plasmid to determine which fragment can restore the normal partitioning properties.



## **A STUDY OF THE MARINE BACTERIA ASSOCIATED WITH BARNACLES IN CHARLESTON HARBOR**

Author: Michelle M. Haynes, George McCowan, and B.R. Stokes

Institution: South Carolina State University

Department: Department of Natural Sciences

The focus of this study was to understand the processes that govern the sequence of interactions among substrata, bacteria, and invertebrate larvae in marine environments, specifically identifying the bacteria associated with barnacles. Samples of bacteria were collected from Charleston Harbor at the South Carolina Wildlife and Marine Resource Division on James Island, SC. Swabbings were taken from barnacles attached to oyster shells from both mid-intertidal (OSM) and low-intertidal (OSL) zones. Isolation of pure cultures were obtained and tests were run to identify of the bacteria. The majority of the bacteria identified were indigenous to the marine environment. Some of the species found from the OSM were *Enterobacter agglomerans*, *Moraxella* species, *Vibrio alginolyticus*, and *Vibrio parahaemolyticus*. Species identified in OSL were *Vibrio cholerae*, and *Pseudomonas cepacia*. Future experiments will consist of monitoring the seasonal occurrence of bacteria associated with barnacles.

Supported by ONR Grant N00014-90-J-4080





## NUCLEAR OR MITOCHONDRIA INHERITANCE OF GAL 32 MUTATION

Author: Patricia Z. McDaniel

Institution: Alabama A&M University, Normal, Alabama

Department: Department of Chemistry

The objective of this study was to determine if the Gal 32 Mutation is nuclear or mitochondrially inherited. To accomplish this, a series of three genetic experiments using four different cell lines of the Gal 32 mutant that are unable to grow in galactose due to a defect in mitochondrial (MT) protein synthesis were conducted. Cells growing in galactose obtain all of their energy aerobically from the MT respiratory chain and oxidative phosphorylation. The MT genome encodes only 13 polypeptides which are components of the respiratory chain and mitochondrially synthesized. Most MT proteins are nuclearly encoded. Gal 32 does not synthesize certain MT encoded proteins; the mutant grows anaerobically in glucose by increasing the rate of glycolysis.



## **SUPERCONDUCTIVITY AND THE MEISSNER-OSCHENFELD EFFECT**

Author: Timothy Minus

Institution: Florida A&M University

Department: Department of Chemical Engineering

In 1908, Kammerlingh Onnes made a discovery which would greatly alter the scientific world. He investigated very low temperature effects (below 4.2K) on the electrical resistance of conductors. His data and observations prompted him to describe what is now known as superconductivity. As a result of Onne's ingenuity, others performed their own experiments, further expanding the field of superconductivity. Meissner and Oschenfeld (1933) conducted their own research that revolutionized the field of superconductivity. Their discovery, is known as the Meissner Effect. Experiments were conducted at Florida A&M University to test the properties of a superconductor and the Meissner Effect. Data were obtained under variable conditions to ensure the validity and accuracy of the experimental procedure.



## THE DEFINITION AND SOME FUNDAMENTAL APPLICATIONS OF THE NUMBER "e"

Author: Jerri Moore, Ralf W. Turner, Debra B Azonobi  
Institution: Florida A&M University  
Department: Mathematics

The number  $e(2.71828\dots)$  is perhaps the second most prominent number in mathematics, but the typical student does not have a clear conception of what the number "e" really is. If a high school or college student of mathematics were to ask "What is  $e$ ?", it will not be unusual to hear such answers as the following:

- (a) it is the base of the natural logarithm
- (b) it is approximately 2.718
- (c) it is an irrational number
- (d) It is a transcendental number
- (e) it is used in calculus
- (f) It is a number like 11 or the square root of two

While all of these responses are not absolutely incorrect they are not correct either, and definitely are not to be used as a definition. The purpose of my presentation is to define the number "e" and provide important applications of "e".



## **GROUND-WATER MODELING FOR NUCLEAR WASTE PERFORMANCE ASSESSMENT**

Author: Linwood Peele and William E. Nichols

Institution: North Carolina A&T State University

Department: Department of Civil Engineering

The objective of this research was to test the ability of a MSTS (Multiphase Subsurface Transport Simulator) to model hydrothermal conditions at Yucca Mountain, Nevada, and to compare the results to TOUGH (Transport of Unsaturated Ground Water and Heat), a well documented and widely used unsaturated flow code. The reliability of the MSTS code was tested and to checked to verify if the mathematical models were correctly coded. The MSTS code was subjected to benchmark testing against the TOUGH code which has been applied primarily to studies of high-level nuclear waste isolation in different conditions that are expected to occur in the environment of the potential repository.

MSTS solves the governing equations for conservation of water mass, air mass, thermal energy, and dilute specie mass for a single specie that may be subject to radioactive decay. All equations except dilute specie mass conservation are solved in a fully coupled mode using an integrated finite difference formulation. One, two, or three-dimensional problems with variable saturation can be solved using the multiple porosity based model in MSTS.





**SITE RESTORATION PROJECT:  
LAWRENCE BERKELEY LABORATORY, CALIFORNIA**

Principal Investigators: Dr. Iraj Javandel, Mohsen Alavi, and Robert Reina

Institution: Texas A&I University, Kingsville, Texas

Department: Geosciences

At Lawrence Berkeley Laboratory (LBL), an environmental assessment to define the persistence of chemical concentrations in soils and effluent waters is underway. Chemical analyses of soil and water samples indicate variable trends in several monitor wells. The site-wide investigation provides information on the potential problem areas and possible methods for abatement.

The purpose of this study is to determine the parameters characterizing the water and soil quality at LBL, identify sources of groundwater contamination, and examine a systematic approach to locate hydrologically sensitive areas.

At many of the facilities on the lab site, various chemicals have been used or manufactured, and possibly discharged into the groundwater in the form of leaks and spills. Groundwater samples are being collected and analyzed to identify both inorganic and organic constituents, using EPA GC/MS method 8260.



**WAVELENGTHS DEPENDENTS OF THE NONLINEAR INDEX OF  
REFRACTION IN AN ORGANIC SYNTHESIZED MATERIAL**

Author: T.L. Swint, M. Henry, R. Brown, M. Joshi, M. Minzurski-Mann, and  
M. Lakshmikatham

Institution: Alabama A&M University, Normal, Alabama

Department: Department of Chemistry, University of Alabama, Tuscaloosa

Self-focusing, a nonlinear optical phenomenon, was used to determine the nonlinear index of refraction ( $n_2$ ) of MUJ16, a synthesized organic material. Six different wavelengths of an Ar<sup>+</sup> laser determined the wavelength dependency of the nonlinear index of refraction. Wavelength dependency of the nonlinear index of refraction was compared to the absorption of the sample over a region including the six wavelengths. The variations in  $n_2$  with the wavelengths imply that the absorption's enhances the value of  $n_2$ .



## AIR POLLUTANTS AFFECTING RESPIRATION IN SEED GERMINATION

Author: Tammie L. Terrell, A. G. Chakrabarti, J.J. Jenkins, and R. Dogra

Institution: South Carolina State University

Department: Department of Natural Sciences

Five crop seed species: soybean (Glycine merr.), cucumber (Cucumis sativus L.), garden pea (Pisum sativum L.) okra (Hibiscus esculentus L.) and string bean (Phaseolus vulgaris L.); and five seed species; crotalaria (Crotalaria spectabilis Roth.), cocklebur (Xanthium strumarium L.), pigweed (Amaranthus retroflexus L.), wild mustard (Sinapis arvensis), and common ragweed (Ambrosia artemisfolia L.) were exposed to 24 ppm of each carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>), during 24 hour of absorption of distilled water. The rate of oxygen consumption (external respiration) was measured for the control and the treated seeds in a standard air tight respirometer utilizing KOH as an absorbent. The results indicated that the rate of respiration was inhibited in all treatments except crotalaria and cocklebur seed species with the (NO<sub>2</sub>) treatment. The same treatments with NO<sub>2</sub> boosted the respiration rate in wild mustard seed species about nine times as compared to the control. This probably occurred due to a specific generic character for the species. The respiration rate was very poor in the SO<sub>2</sub> environment in crop seed species unlike the weed seed species. This project was sponsored by 1890 Grant S.C. 120-11-89



## **MICROBIAL ENHANCED OIL RECOVERY UTILIZING VENEZUELAN OILS**

Author: S.Y. Walker, G. Premuzic, M. Lin and P. Kale

Institution: Alabama A&M University, Normal, Alabama

Department: Brookhaven National Laboratory and Alabama A&M University

This project deals with the prospects of Microbial Enhanced Oil Recovery (MEOR). Because of the costs associated with two Enhanced Oil Recovery (EOR) Techniques, thermal recovery and chemical treatment, more and more researchers are now studying MEOR. Consequently, nine bacterial strains were used to determine their potential to degrade two highly-viscous, high-sulfur, heavy crude oils and one waste by product oil. Biodegradation experiments were conducted at 65°C and room temperatures. Agitation environments, pH extremes and low-carbon media studies were conducted for each strain. Hydro-carbon content drastically declined when measured on the Gas Chromatography Mass Spectrometer (GC-MS). Preliminary results show that future research developments and applications are needed.





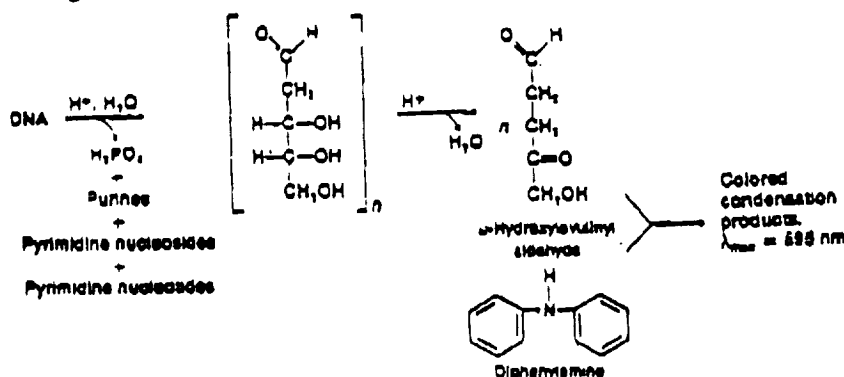
## DIPHENYLAMINE ASSAY FOR RESIDUAL CALF THYMUS DNA

Author: C.C. Williams, S. Stevens, M.C. Henry, D.S. Moore, Ph.D.

Institution: Howard University

Department: Department of Chemistry

In order to determine if any DNA remains in various supernatant solutions obtained in the isolation of nuclease treated cell nuclei from calf thymus glands, we have employed the diphenylamine (or Dische) DNA method of assay [K.W. GILES and A. Myers, *Nature* (London) **206**, 93(1965)]. This assay method is based upon the following chemical reactions:



The amount of DNA is proportional to the amount of colored products obtained in the last reaction of the above sequence. By measuring the absorbance of the colored solutions near 595nm for solutions of known DNA concentration (standards), the concentrations of DNA in unknown solutions may be determined by comparison.

We used calf thymus nuclei that had been treated, briefly, with a DNA digesting enzyme (a nuclease). We were interested in determining how much of the digested DNA had leaked from the nuclei (remaining in supernatant) after pelleting the nuclei by centrifugation. After nuclease treatment, the nuclei were pelleted (by high speed centrifugation) three successive times and the resulting three supernatants assayed. The results indicate that the most significant amount of DNA leakage occurred during the first centrifugation. We conclude that DNA leakage does occur from nuclease treated calf thymus cell nuclei.



## **EVALUATION OF BIOVENTING AS A REMEDIATION TECHNIQUE FOR HC CONTAMINATED SOILS IN THE VADOSE ZONE**

Author: Allen D. Walzel and Drs. R.N. Finch and Stephen E. Herbes

Institution: Texas A&I University

Department: Environmental Engineering

My name is Allen Walzel. I am a graduate student at Texas A&I University pursuing a Masters degree in environmental engineering. Over the summer I had the opportunity to fulfill a ten week commitment at a DOE facility, the Oak Ridge National Laboratory. This exposure provided a direction for my thesis work which will deal with remediation of soils in the vadose zone contaminated by hydrocarbons, with emphasis particularly on the less volatile and or more recalcitrant components.

When dealing with soils in the vadose zone, methods for the restoration of a hazardous waste contaminated site can be categorized as follows: (1) conventional clean-up consisting of overexcavation and off-site disposal, (2) on-site remediation in which the impacted soils have been removed and are treated on the surface, and (3) in situ remediation or treatment in place.



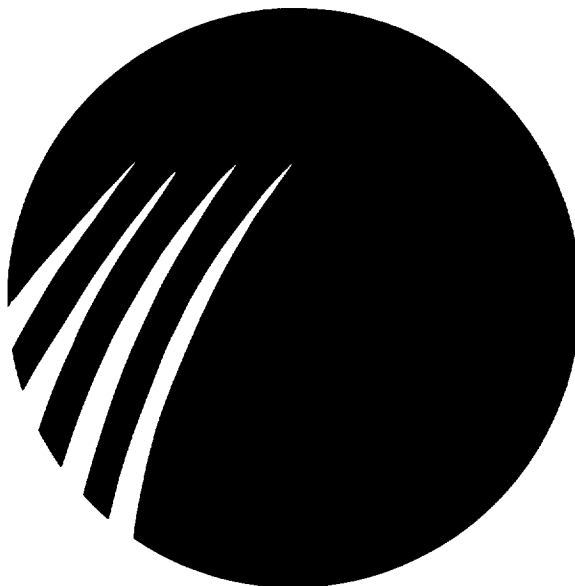
## **APPENDIX 7**

**"A Forum on Undergraduate Research  
Experiences of Minority Science, Mathematics and  
Engineering Students and A Workshop on  
Graduate School Opportunities"**

***List of Participants***



# PROGRAMME PARTICIPANTS



*A FORUM ON UNDERGRADUATE RESEARCH  
EXPERIENCES OF MINORITY SCIENCE ,  
MATHEMATICS AND ENGINEERING STUDENTS  
AND  
A WORKSHOP ON GRADUATE SCHOOL  
OPPORTUNITIES*

OCTOBER 15-17 1992

**GEORGIA WORLD CONGRESS CENTER  
and  
CLARK ATLANTA UNIVERSITY**

ATLANTA, GEORGIA





## PROGRAMME PARTICIPANTS

### HBCU/MI INSTITUTIONS

#### **ALABAMA A&M UNIVERSITY**

**4900 Meridian Street, N**

**Normal, AL 35762**

**(205) 851-5000**

##### **Students**

Tanya Cook  
Delicia Corey  
Darlene Davis  
Danielle Ditts  
Corey Grant  
Crystal Green  
Shermon Howard  
Bridget Hunter  
Stephanie Johnson  
Patrice McDaniels  
Kelvin Minniefield  
Augustina Onuoha  
David Richardson  
Tracy Swint  
Ken Thompson  
Sophia Y. Walker  
Kimberley Washington  
Paul Williams  
Quardralyne Wilson

Chemistry  
Mathematics  
Mathematics  
Physics  
Plant and Soil Science  
Physics  
Environmental Science  
Chemistry  
Mathematics  
Chemistry  
  
Physics  
Mathematics  
Physics  
Chemistry  
Zoology  
Biology/Environmental Science  
  
Physics

##### **Faculty**

Sunnie Aburime  
Rather Brown

Plant & Soil Science

#### **ALABAMA STATE UNIVERSITY**

**915 S. Jackson Street**

**Montgomery, AL 36101**

**(205) 293-4100**

##### **Students**

Melanie Banks  
Shuntele Burns  
Michael Hawkins  
Kenya Marcus  
Odesha Martin  
Stephanie Smith

Mathematics  
  
Mathematics/Computer Science  
  
Chemistry

##### **Faculty**

Thelma Ivery  
Evelyn White  
Yvonne Williams

## PROGRAMME PARTICIPANTS

2

### **ALBANY STATE COLLEGE**

**504 College Drive  
Albany, GA 31705  
(312) 430-4600**

#### **Students**

Antoinette Cook  
Zenja Evans  
Mark Gooden  
Cedrick Guyton  
Eric Laster  
Kendall Mitchell  
Karen Small  
Erica Wallace

Mathematics & Computer Science  
Engineering  
Mathematics & Computer Science  
Biology  
Mathematics & Computer Science  
Biology  
Mathematics & Computer Science  
Mathematics & Computer Science

#### **Faculty**

Gwendolyn Campbell  
Connie Legett

Computer Science  
Mathematics

### **BENNETT COLLEGE**

**900 E. Washington Street  
Greensboro, SC (919) 273-4431  
(919) 273-4431**

#### **Students**

Shahnaz Chowdury  
Miriam Gaines  
Batsirai Mutasa  
Valarie Reed  
Rosalie Yemba

Engineering

Physics/Mathematics  
Engineering  
Biology

#### **Faculty**

Deena Davis  
Richard L. Ponting

Physics

### **BOWIE STATE UNIVERSITY**

**1400 Jericho Park Road  
Bowie, MD 20715  
(301) 464-3000**

#### **Students**

Angela Hall  
Antonette F. Morris  
Jillian Wardally  
Edward Yeldell

Computer Science  
Biological Science  
Mathematics  
Computer Science

#### **Faculty**

Douglas Council  
Joan Langdon

Mathematics

## PROGRAMME PARTICIPANTS

3

### ***CALIFORNIA STATE UNIVERSITY***

***5151 State University Drive***

***Las Angeles, CA 90032***

***(213) 343-3000***

#### **Students**

Melanie Curtis

Arturo Diaz

Maximilian Fernandez

Jose Meza

Biology

#### **Faculty**

Pheobe Dea

Chemistry

### ***CATHOLIC UNIVERSITY OF PUERTO RICO***

***Ponce, PR 00732***

***(809) 841-2000***

#### **Students**

Mariceli Medina

Solgrisel Rodriguez

Felix Sillvagnoli

Chemistry

Biology

General Sciences

#### **Faculty**

Josea Torres

Biochemistry

### ***CAYEY UNIVERSITY COLLEGE***

#### **Students**

Migdalia Alvarado

Crisandel Felix

Onofre Ortiz

Mayra Pagan

Rosa Soto

Carol Torres

Chemistry

Chemistry

Chemistry

Chemistry

Chemistry

Mathematics & Physics

#### **Faculty**

Felix Velazquez

Biology

### ***CENTRAL STATE UNIVERSITY***

***Wilberforce, OH 45384***

***(513) 376-6011***

#### **Students**

Charles Byrd

Keith James

Manufacturing Engineering

Water Resources Management

## PROGRAMME PARTICIPANTS

4

**CENTRAL STATE UNIVERSITY**  
**Wilberforce, OH 45384**  
**(513) 376-6011**

Eric Jones  
Felipe Mesa  
Lisa Wilson

**Faculty**  
Ayayi Majebi  
Victor Okereke

Gloria Simmons

Water Resources Management  
Manufacturing Engineering  
Manufacturing Engineering

Manufacturing Engineering  
International Center for Water Resources  
Management  
Manufacturing Engineering

James Sangster

Arthur Thomas

Institute for Development and International  
Affairs  
President

**CHEYNEY UNIVERSITY OF PENNSYLVANIA**  
**Cheyney, PA 19319**  
**(215) 399-2000**

**Students**  
Kathyne Moorehead  
Joey Pennix  
Conswalla Shavers  
Rosalyn Swiggett

**Faculty**  
Henry Hardy  
Eugene Jones

Mathematics  
Computer Science  
Biology  
Mathematics & Computer Science

**CLARK ATLANTA UNIVERSITY**  
**223 James P. Brawley Drive, SW**  
**Atlanta, GA 30314**  
**(404) 880-8000**

**Students**  
Al-Amin Ally  
Ejinkonye Anekwe  
Amy Arthur  
Samesha R. Barnes  
Anthony Bell  
Andrea Bowens  
Eric Brittain  
Kenneth A. Brown  
Warren Brownlee  
Jacqueline Carr

Physics/Engineering  
Biology  
Chemistry /Chemical Engineering  
Chemistry/Chemical Engineering  
Computer Science  
Chemistry  
Computer Science  
Physics  
Physics  
Computer Science

## PROGRAMME PARTICIPANTS

5

### *Clark Atlanta University (Continued)*

#### **Students (Continued)**

|                       |                               |
|-----------------------|-------------------------------|
| Dhanfu Elston         | Biology                       |
| Corey C. Echols       | Physics                       |
| Susan Fossett         | Mathematics                   |
| Neysa Foy             | Computer Science              |
| Enid Gatimu           | Chemistry                     |
| Corey Gibson          | Computer Science              |
| Lamond Godwin         | Computer Science              |
| Jennifer Hamilton     | Computer Science              |
| Henry Hayes           | Mathematics                   |
| Lendozia Hayes        | Mathematics                   |
| Corliss D. Heath      | Mathematics                   |
| Dwight Hugget         | Computer Science              |
| Gwendolyn Irby        | Mathematics                   |
| Philippe Jean-Bart    | Biology                       |
| Shirlan Johnson       | Physics / Mathematics         |
| LaVonn Jones          | Physics / Mathematics         |
| Arun Kori             | Chemistry                     |
| Nikita Lee            | Computer Science              |
| Kojo Linder           | Physics                       |
| Jelyne Martin         | Computer Science              |
| Motodi Maserumula     | Mathematics                   |
| Victorine McDonald    | Chemistry                     |
| Crystal Moffett       | Biology                       |
| Rene Morrow           | School of Business            |
| Michael Ojiawu        | Computer Science              |
| Nathaniel Onunekwu    | Computer Science              |
| Siby Panthiruvellil   | Computer Science              |
| Sandra Placide        | Computer Science              |
| Benjamin Pointer      | Computer Science              |
| Denise Powell         | Biology                       |
| Byron Roberson        | Computer Science              |
| Keithia C. Simpson    | Mathematics/Civil Engineering |
| Brett Sims            | Mathematics                   |
| Wallace Smith         | Chemistry                     |
| Sonya Snelling        | Computer Science              |
| Dawn Stephens         | Engineering/Mathematics       |
| Avare Stewart         | Computer Science              |
| Jastasia Thomas       | Computer Science              |
| Paul Thomas           | Chemistry                     |
| Angel Torres          | Mathematics                   |
| Terri Turner          | Physics                       |
| Gayla Wilson          | Chemistry                     |
| Kanoktip Youngchareon | Computer Science              |

#### **Faculty**

|                  |                             |
|------------------|-----------------------------|
| Godfried Abosti  | Research Center             |
| Hezekiah Adeyemi | Mathematics                 |
| Tiejun Bai       | Research Center/Engineering |

## PROGRAMME PARTICIPANTS

6

### *Clark Atlanta University (Continued)*

#### **Faculty (Continued)**

Judith Bender  
Daniel Bessis  
Kofi B. Bota  
Irene Brown  
John Browne  
Isabella Finkelstein  
Roy George  
Denise Graves  
Ernauld Graves  
Carlos Handy  
Calvin Jackson  
Byron Jeff  
Joe Johnson  
Henry McBay  
Thomas Mensah  
Ronald Mickens  
Eric Mintz  
Mark Mitchell  
Lebone Moeti  
Magdi Morsi  
Alfred Msezane  
Paul Musey  
Henry Neal  
Cass Parker  
Kenneth Perry  
Augusto Rodriguez  
Man Sharma  
Jatinder Singh  
Om Sinha  
Abdulalim Shabazz  
Juarine Stewart  
Niranjan Talukder  
Swaraj Tayal  
Charles Thompson  
Lourdes Torres  
Nazir Warsi  
Melvin Webb

Research Center/Biology  
Physics  
Research Center  
Biology  
Biology  
Biology  
Computer Science  
Research Center/Physics  
AT&T Visiting Scientist  
Physics  
Mathematics  
Computer Science  
Research Center/Biology  
Chemistry  
Research Center  
Physics  
Chemistry  
Chemistry  
Research Center/Chemical Engineering  
Computer Science  
Physics  
Biology  
Physics  
Chemistry  
Computer Science  
Chemistry  
Center for Academic Computing/Mathematics  
Research Center/Engineering  
Physics  
Mathematics  
Biology  
Physics/Engineering  
Physics  
Computer Science  
Chemistry  
Computer Science  
Biological Sciences

Georgianna Bolden  
Richard Bright  
August Curley  
Martha A. Edwards  
Denise Higgins  
Carol Johnson  
Bernice Jones  
Barbara Lane  
Faye Lyons-Gary

Sponsored Programs  
The HBCU/MI Consortium  
The HBCU/MI Consortium  
UMARC Program  
CEPER Center  
Sponsored Programs  
The HBCU/MI Consortium  
Sponsored Programs  
The HBCU/MI Consortium

## PROGRAMME PARTICIPANTS

7

### ***Clark Atlanta University (Continued)***

Gisele Parker  
Pauline Moore  
Phayonie Nugent  
Stevie Thomas  
Roxane Viard  
Audrey Wagner  
Jackie Williams

The HBCU/MI Consortium  
Sponsored Programs  
HiPPaC Center  
The HBCU/MI Consortium  
Sponsored Programs  
Sponsored Programs  
The HBCU/MI Consortium

***ELIZABETH CITY STATE UNIVERSITY***  
***1704 Weeksville Road***  
***Elizabeth City, NC 27909***  
***(919) 335-3230***

#### **Students**

Tammy Askew  
Belinda Banks  
Renee Basnight  
Willie Basnight  
Corey Cooper  
Karen Fulton  
Deborah Jones  
Stephanie Vaughn

Mathematics/Computer Science  
Mathematics/Computer Science  
Mathematics/Computer Science  
Mathematics/Computer Science  
Mathematics/Computer Science  
Chemistry  
Mathematics/Computer Science  
Mathematics/Computer Science

#### **Faculty**

Linda Hayden

Mathematics/Computer Science

***FISK UNIVERSITY***  
***1000 17th Avenue, NW***  
***Nashville, TN 37208-3051***  
***(615) 329-8500***

#### **Students**

Regina Arvon  
Michelle Foy  
Corliss Johnson  
Leroy Salary

Biology  
Mathematics and Computer Science  
Chemistry  
Mathematics & Computer Science

#### **Faculty**

Leroy Murray  
John Springer

Mathematics & Computer Science  
Physics

***FLORIDA A&M UNIVERSITY***  
***Tallahassee, FL 32307***  
***(904) 599-3000***

#### **Students**

Kendall Campbell  
Jolietta Eddings

Chemistry  
Engineering

## PROGRAMME PARTICIPANTS

8

### **Florida A&M University (Continued)**

#### **Students (Continued)**

Stephanie Humphrey  
Taisha Jones  
Maurice Lindsey  
Timothy Minus  
Jerri Moore

Electrical Engineering  
Agribusiness  
Agriculture  
Bio-Medical Engineering  
Actuary Sciences

#### **Faculty**

Dedra Azonobi  
Ray Shackelford

Evelyn Hall  
Linda Hudson  
Frederick Humphries

Graduate Studies  
President

### **FLORIDA INTERNATIONAL UNIVERSITY** **University Park** **Miami, FL 33199** **(305) 348-2000**

#### **Students**

Maritza Carballo  
Beatrice Cazanias  
Richard Davis  
Ivan Muguguercia

Mechanical Engineering

#### **Faculty**

Ali Ebadian  
Norman Munroe

Mechanical Engineering  
Mechanical Engineering

### **HAMPTON UNIVERSITY** **East Queen Corner of Tyler** **Hampton, Virginia 23668** **(804) 727-5000**

#### **Students**

Michelle Adams  
Peter T. Agbakpe  
Divine Ametepé  
Angela Ballance  
Cherie Campbell  
Christopher Carter  
Danielle D. France  
Shawn Gainor  
Ray A. Gilmore  
David Green  
Willette Johnson

Mathematics  
Mathematics  
Mathematics  
Marine & Environmental Science  
Mathematics  
Chemistry  
Chemistry  
Mathematics  
Mathematics  
Mathematics



## PROGRAMME PARTICIPANTS

9

### ***Hampton University (Continued)***

#### **Students (Continued)**

|                 |             |
|-----------------|-------------|
| Martin Khumbah* | Mathematics |
| John Kwagyan    | Mathematics |
| Terry Logan     | Mathematics |
| Rashawyn Morris |             |
| Simone Moses    |             |
| Albert Opher    | Mathematics |
| Michelle Penn   |             |
| Lemuel Riggins  | Mathematics |
| Haquisha Taylor | Mathematics |
| Maurice Toval   | Engineering |
| Martha Turner   | Mathematics |
| Terrance Wilson | Mathematics |

#### **Faculty**

|                    |             |
|--------------------|-------------|
| John Hurley        | Mathematics |
| Wing Leung         |             |
| Eduardo Socolovsky | Mathematics |
| James C. Turner    | Mathematics |
| Isai Urasa         | Chemistry   |

|               |             |
|---------------|-------------|
| Illona Turner | Mathematics |
|---------------|-------------|

**HOWARD UNIVERSITY**  
**2400 6th Street, NW**  
**Washington, DC 20059**  
**(202) 806-6100**

#### **Students**

|                  |                   |
|------------------|-------------------|
| Shauna Anderson  | Mathematics       |
| Willie Johnson   | Civil Engineering |
| Stacey McCall    | Biology           |
| Scott Spaulding  | Civil Engineering |
| Winston Williams | Civil Engineering |

#### **Faculty**

|                 |                   |
|-----------------|-------------------|
| Broderick Eribo | Biology           |
| K. Ocran        | Civil Engineering |
| Paul Thompson   | Com SERC          |

\*Hampton University/University of D.C.

## PROGRAMME PARTICIPANTS

10

**JACKSON STATE UNIVERSITY**  
**1325 J.R. Lynch Avenue**  
**Jackson, MS 39217**  
**(601) 968-2121**

### **Students**

Michael Davis  
Marcia Jones  
Toshma Thomas  
Andre Warren  
Pamela D. Weathersby  
Jacqueline West

Biology  
Biology  
Biology  
Computer Science  
Biology  
Computer Science

### **Faculty**

T. Haile  
Dianne J. Love

Computer Science  
Biology

Shelton Swanier

Office of the Dean

**JOHNSON C. SMITH UNIVERSITY**  
**100 Beatties Ford Road**  
**Charlotte, NC 28216**  
**(704) 378-1000**

### **Students**

Donna Crawford  
Melva Green  
Ashley Hardy  
Sandra McClinton  
Carlton Riddick

Mathematics & Computer Science  
Mathematics & Computer Science  
Mathematics & Computer Science  
Mathematics & Computer Science  
Mathematics & Computer Science

### **Faculty**

John Adeyeye  
Ben Dias

Mathematics & Computer Science  
Chemistry

**LANGSTON UNIVERSITY**  
**P. O. Box 718**  
**Langston, OK 73050**  
**(405) 466-2231**

### **Students**

Thomas Braxton  
Bridget Moore  
Lenard Smith  
Preston Solomon

### **Faculty**

Zola Drain  
Philip Schapiro

Biology  
Mathematics

## PROGRAMME PARTICIPANTS

11

**LINCOLN UNIVERSITY**  
**Lincoln University, PA 19352**  
**(215) 932-8300**

**Students**

|                  |           |
|------------------|-----------|
| Ndidi Azikiwe    | Chemistry |
| Tabbetha Dobbins | Physics   |
| Lee Johnson      | Physics   |
| Alexis McRae     | Biology   |

**Faculty**

|                |           |
|----------------|-----------|
| Mazharul Huq   | Physics   |
| Tjama Tjivikua | Chemistry |

**MOREHOUSE COLLEGE**  
**830 Westview Drive, SW**  
**Atlanta, GA 30314**  
**(404) 681-2800**

**Students**

|                    |             |
|--------------------|-------------|
| Kwadwo Appiah      | Physics     |
| Jamy Ard           | Biology     |
| Derek Crain        | Mathematics |
| Bryan Derrisson    | Biology     |
| F. Desilva         | Biology     |
| Charles Freeman    | Biology     |
| Gregory T. George  | Biology     |
| Laurence Humphries | Biology     |
| Jamie Joshua       | Physics     |
| Torin Malone       | Engineering |
| Charles Montgomery | Mathematics |
| M. Williams        | Biology     |

**Faculty**

|                   |         |
|-------------------|---------|
| Errol Archibold   | Biology |
| Clarence Clark    | Biology |
| Curtis Clark      | Biology |
| David Cooke       | Biology |
| J. K. Haynes      | Biology |
| Keith Howard      | Biology |
| Joseph McCray     | Biology |
| Rosalyn Patterson | Biology |
| Ajit Samarasinghe | Biology |

## PROGRAMME PARTICIPANTS

12

### **MORRIS BROWN COLLEGE**

**643 Martin Luther King, Jr. Drive, NW  
Atlanta, GA 30314  
(404) 220-0190**

#### **Students**

Debra Coaxum  
Maurice L. Dennard  
Urhonda Hines  
Rupert Nedd  
Tasha Quarterman  
Robyn M. Scott  
Kelvin Tolbert

Mathematics  
Computer Science  
Mathematics  
Computer Science  
Mathematics  
Mathematics  
Computer Science

#### **Faculty**

Raghunath Bhongiri  
Mattie Booker  
Silas Edet  
Godwin Ekeke  
Cornell Grant  
Issifu Harruna  
Abiola Lawal  
Alan Lipkin  
Mohsen Mahmoudi  
Henry Porter  
Peter Roessle  
Donald Smith

Computer Science  
Mathematics  
Mathematics  
Mathematics  
Mathematics  
Chemistry  
Mathematics  
Chemistry  
Mathematics  
Mathematics  
Chemistry  
Mathematics

### **NEW MEXICO HIGHLANDS UNIVERSITY**

**Las Vegas, NM 87701  
(505) 454-3552**

#### **Students**

Anita L. Archibeque  
Armando Furlano  
Crystal Furlano  
Edward A. Martinez

Environmental Science (Geology)  
Environmental Science  
Environmental Science  
Environmental Science

#### **Faculty**

Nancy Kirkpatrick  
Robert Lessard

Physical Science  
Physical Science

### **NORTH CAROLINA A&T STATE UNIVERSITY**

**1601 East Market Street  
Greensboro, NC 27411  
(919) 334-7500**

#### **Students**

Serese Aranha  
Vadry Austin  
Joseph Brown  
Hurley Foulk

Civil Engineering  
Civil Engineering  
Civil Engineering  
Civil Engineering

## PROGRAMME PARTICIPANTS

13

### ***North Carolina A&T State University***

#### **Students (Continued)**

|                   |                                |
|-------------------|--------------------------------|
| Sonja Hines       | Occupational Safety and Health |
| Darren Moxey      | Civil Engineering              |
| Linwood Peele     | Civil Engineering              |
| John Ponder II    | Civil Engineering              |
| James Reid        | Civil Engineering              |
| Alicia Steele     | Civil Engineering              |
| Tomiko Sturdivant | Civil Engineering              |
| Ely Wendell       | Occupational Safety and Health |
| Tatia White       | Civil Engineering              |
| Tammy Wooten      | Civil Engineering              |

#### **Faculty**

|                 |                   |
|-----------------|-------------------|
| Shoou-Yuh Chang | Civil Engineering |
|-----------------|-------------------|

|                |                        |
|----------------|------------------------|
| Jim McDuffie   | The HBCU/MI Consortium |
| Sharon Waldron |                        |

### ***NORTH CAROLINA CENTRAL UNIVERSITY***

***Box 71002***

***Raleigh, NC 27695-7102***

***(919) 515-7461***

#### **Students**

|                   |           |
|-------------------|-----------|
| Mehul Desai       | Physics   |
| Janel Meryweather | Chemistry |
| Walter Sansbury   | Physics   |
| Treva Stephens    | Chemistry |

#### **Faculty**

|           |         |
|-----------|---------|
| Kenny Kim | Physics |
|-----------|---------|

### ***NORTHERN ARIZONA UNIVERSITY***

***Flagstaff, AZ 86011***

***(602) 523-9011***

#### **Students**

|                   |                       |
|-------------------|-----------------------|
| Adam Lederer-Cano | Environmental Science |
| Lorencita Martin  | Dental Hygiene        |
| Telletha Valenski | Chemistry             |
| Maeumeka Wero     | Environmental Science |

#### **Faculty**

|                |   |
|----------------|---|
| Gerald Caple   | Office of Research and Graduate Studies |
| Henry Hooper   | Biology                                 |
| Harold Speidel |   |

## PROGRAMME PARTICIPANTS

14

**OAKWOOD COLLEGE**  
**Huntsville, AL 35896**  
**(205) 726-7000**

**Students**

Amalia Brooks  
Andy Knight  
Belvia Matthews  
Lynette Mays  
Nzisa Mutinga  
Kimberly Thomas  
Jewell Walker  
Zsakeba Watkins

**Faculty**

Karen Benn  
Kenneth LaiHing  
Ava Rivers

Chemistry  
Allied Health

**PRAIRIE VIEW A&M UNIVERSITY**  
**Prairie View, TX 77446**  
**(409) 857-3311**

**Students**

Felicia Biggers  
Fredrick Butler  
Kelly Doakes  
LaRhonda Holoman

**Faculty**

Hylton McWhinney  
John Williams

Environmental Programs Coordinator  
Chemistry

**RUST COLLEGE**  
**150 E. Rut Avenue**  
**Holly Springs, MS 38635**  
**(601) 252-4661**

**Students**

Antoine Carter  
Quentell Gibson  
Joe Jones  
Latisha Jones  
Joyce Kincaid  
Valerie Moore  
Charise Sumler  
Reeka Williams

Computer Science  
Computer Science  
Chemistry  
Biology  
Biology  
Computer Science  
Computer Science

**Faculty**

K. H. Kulkarni  
M. R. Uddin

## PROGRAMME PARTICIPANTS

15

**SAVANNAH STATE COLLEGE**  
**Savannah, GA 31404**  
**(912) 356-2187**

**Students**

Melba Coles

Zandra Fripp

Jonetta Gaddis

Tanglea S. Tharpe

Computer Science

Biology

**Faculty**

Govindan Nambiar

Biology

**SOUTH CAROLINA STATE UNIVERSITY**  
**300 College Street, NE**  
**Orangeburg, SC 29115**  
**(803) 536-7000**

**Students**

Dhaya Chandrasegaram

Michele Haynes

Bruce Haywood

Jillian Hinkson

Jarrel Holmes

Leyana Lloyd

George McCowan

James Simmons

Tammy Terrell

Biology

Biology

Physics

English

Biology

Biology

Biology

Physics

Biology

**Faculty**

Carl Clark

James Stukes

Physics

Biology

**SOUTHERN UNIVERSITY AT BATON ROUGE**  
**Baton Rouge, LA**  
**(504) 771-4500**

**Students**

Charles E. Bethley

Malissa Bethly

Roderick Bethly

Alysia Brazier

Chaneitha Hampton

Barbara Lynch

Cassandra Mack

Bonique D. Pillot

Ebonique Pillot

Shawn L. Pullum

Tracy Ricard

LaSandra Robinson

Khaison Wyandon

Chemistry

Mathematics

Physics

Mathematics

Physics

Engineering

Chemistry

Physics

Physics

Computer Science

Engineering

Biology

Engineering

## PROGRAMME PARTICIPANTS

16

### **Southern University at Baton Rouge**

#### **Faculty**

Robert Ford  
Ella Kelley  
Chukwu Onu

Chemistry  
Civil Engineering

Ralph Jennings  
Kimberly Keller

EPA Visiting Scientist

### ***SOUTHERN UNIVERSITY AT NEW ORLEANS***

***6400 Press Drive  
New Orleans, LA 70126  
(504) 286-5000***

#### **Students**

LaJuan Magee  
Michael Mossey  
Mark Ross  
Gerald Spears

Mathematics  
Computer Science  
Computer Science  
Mathematics

#### **Faculty**

Matthew Causey  
Ernest London

Mathematics  
Business Administration

### ***SPELMAN COLLEGE***

***350 Spelman Lane, SW  
Atlanta, GA 30314  
(404) 681-3643***

#### **Students**

Yolanda Bennett  
Erika Brown  
Lia Haynes  
Tanya Henneman  
Michelle Jones  
Marcia Lockett  
Tressa Scineaux  
Erica Whitney

Mathematics  
Biology  
Biology  
Mathematics  
Mathematics  
Biology  
Biology  
Chemistry

### ***ST. THOMAS UNIVERSITY***

***16400 NW 32nd Avenue  
Miami, FL 33054  
(305) 625-6000***

#### **Students**

Darby Cacdac  
Toni Delamaza  
Clive Rahamut-Ali  
Mark Zawadski

Computer Science  
Biology  
Biology  
Biology



## PROGRAMME PARTICIPANTS

17

### **Faculty**

Ping Ng  
Donna Price

Computer Science  
Biology

**TALLADEGA COLLEGE**  
**627 W. Battle**  
**Talladega, AL 35160**  
**(205) 362-0206**

### **Students**

Erika Boone  
Phyllis Cornelius  
Torra Elder  
Anthony Henderson  
Tanzania Humes  
Tajuana Martin  
Tara Mennefield  
Melvin Wiliams

Biology  
Biology  
Biology  
Chemistry  
Biology  
Biology  
Biology  
Chemistry

### **Faculty**

Larry Drummond  
Charlie Stinson

Biology  
Chemistry

**TENNESSEE STATE UNIVERSITY**  
**3500 John Merritt Boulevard**  
**Nashville, TN 37209**  
**(615) 320-3131**

### **Students**

Zabiollah Azadi  
Keith Bailey  
Cheryl Bledsoe  
Nishelle Clayton  
Jeffrey Conner  
Calvin Davis  
Karen Davis  
Victoria McGee  
Stephanie Rolle  
Brian Willhite

Mathematics

Mathematics

### **Faculty**

Arnold Dean  
James Holloway  
Kofi Semenya

## PROGRAMME PARTICIPANTS

18

**TEXAS A&I UNIVERSITY**  
**Kingsville, TX 78363**  
**(512) 595-2111**

**Students**

Robert Reina  
Allen Walzel

Geosciences  
Environmental Engineering

**Faculty**

Ray Finch  
Thomas McGehee

Environmental Engineering  
Geosciences

**TEXAS SOUTHERN UNIVERSITY**  
**3100 Cleburne Avenue**  
**Houston, TX 77004**  
**(713) 773-0543**

**Students**

Holton V. Buggs, Jr.  
Melanie Nicks  
Richard Smith  
Lamont Terrell

Environmental Engineering Technology  
Environmental Health  
Chemistry  
Chemistry

**Faculty**

Judith Mazique

Laura H. Blanks  
Bobby Wilson

**TUSKEGEE UNIVERSITY**  
**Tuskegee, AL 36088**  
**(205) 727-8157**

**Students**

Jacqueline Clark  
Cedric Facison

Mathematics  
Mathematics

**Faculty**

Leisa James  
Eddie Paramore

Mathematics

**UNIVERSITY OF MARYLAND, EASTERN SHORE**  
**Princess Anne, MD 21853**  
**(410) 651-2200**

**Students**

Laurie Armfield  
Fred Jenkins  
Tiffany Smith  
Schadale Stevens

Biology  
Biology  
Biology  
Biology

## PROGRAMME PARTICIPANTS

19

### ***University of Maryland, Eastern Shore***

#### **Faculty**

Joseph Dodoo

Biology

Joseph Okoh

Biology

### ***UNIVERSITY OF PUERTO RICO, HUMACAO***

#### ***Cuh Station***

***Humacao, PR 00661***

***(809) 850-0000***

#### **Students**

Hector Carrasquillo

Industrial Chemistry

Wendra Collet

Industrial Chemistry

Olga Jaca

Chemistry

Sharon Ortiz-Velazquez

Industrial Chemistry

#### **Faculty**

Sonia Vazquez

Chemistry

### ***UNIVERSITY OF TEXAS AT EL PASO***

***500 West University Avenue***

***El Paso, TX 79968***

***(915) 747-5000***

#### **Students**

Elizabeth Barraza

Civil Engineering

Ana M. Castillo

Civil Engineering

Michael Torres

Civil Engineering

Adriana Ybarra

Mechanical Engineering

#### **Faculty**

Carlos Ferregut

Mary C. Robbins

Mechanical & Industrial Engineering

### ***WINSTON-SALEM STATE UNIVERSITY***

***601 Martin Luther King, Jr. Drive***

***Winston-Salem, NC 27110***

***(919) 750-2000***

#### **Students**

Stephanye D. Armstrong

Chemistry

Roshon Brown

Anthony Segers

Physical Science

Stamarion Watts

#### **Faculty**

Deva Sharma

Physical Science

## PROGRAMME PARTICIPANTS

20

### **XAVIER UNIVERSITY OF LOUISIANA**

**7325 Palmetto Street  
New Orleans, LA 70125  
(504) 483-7411**

#### **Students**

Bennetta M. Cannon  
Temeka L. Fairley  
Carita T. Shanklin  
William Washington  
Alexandra Zippert

Biology  
Biology  
Political Science  
Chemistry  
Chemical Engineering

#### **Faculty**

Warren Flint  
Peter Martinat

Center for Environmental Programs  
Biology

## PROGRAMME PARTICIPANTS

21

### MAJORITY INSTITUTIONS

**BROWN UNIVERSITY**  
*Providence, RI 02912*  
*(401) 853-1000*

**Students**  
William Etienne

**Faculty**  
Bernard Bruce

Graduate School

**CARNEGIE MELLON UNIVERSITY**  
*5000 Forbes Avenue*  
*Pittsburgh, PA 15213*  
*(412) 268-2000*

**Faculty**  
William Hrusa  
Steven Shreve

Mathematics  
Mathematics

**COLUMBIA UNIVERSITY**  
*West 116th Street and Broadway*  
*New York, NY 10027*  
*(212) 854-1754*

**Faculty**  
Leonard Fine

Chemistry

**CORNELL UNIVERSITY**  
*Ithaca, NY 14853-2801*  
*(607) 255-2000*

**Faculty**  
Dotsevi Sogah

Chemistry

Eleanor Reynolds

Graduate School

**DARTMOUTH COLLEGE**  
*Hanover, NH 03755*  
*(603) 646-1110*

**Faculty**  
Michael Walters

Chemistry

## PROGRAMME PARTICIPANTS

22

**DUKE UNIVERSITY**  
**Erwin Road**  
**Durham, NC 27710**  
**(919) 684-8111**

**Faculty**

Athos Ottolenghi  
Jeffrey Peirce  
J. H. Pate Skene  
Kathleen Smith

Pharmacology  
Civil & Environmental Engineering  
Neurobiology  
Biological Anthropology

Aleane Webb

Graduate School

**EMORY UNIVERSITY**  
**Atlanta, GA 30322**  
**(404) 727-6123**

**Faculty**

Louis DeFelice

Anatomy & Cell Biology

Kharen E. Fulton

**GEORGIA INSTITUTE OF TECHNOLOGY**  
**Atlanta, GA 30332**  
**(404) 894-2000**

**Students**

Jimmy Davis  
Jelyne Martin

Graduate Student  
Computer Science

**Faculty**

Erian Armanios  
E. Kent Barefeld  
Oshraf Badir  
Kurt P. Eiselt  
William Gamble  
Jack Hale  
Richard LeBlanc  
Leonard McGuinnis  
Gary S. May  
Thomas F. Moran  
Keith Oden  
Jeffrey Streater  
Leonard Starks  
Thomas Tornabene  
Guy Vickers  
William Weper

Aerospace Engineering  
Chemistry  
Aerospace Engineering  
College of Computing  
AJAX Placement Center  
Mathematics  
College of Computing  
Industrial and Systems Engineering  
Engineering  
Chemistry  
Engineering  
Mechanical Engineering  
Chemistry  
Applied Biology  
Pre-College Director  
Engineering

## PROGRAMME PARTICIPANTS

23

**HARVARD UNIVERSITY**  
**1350 Massachusetts Avenue**  
**Cambridge, MA 02138**  
**(617) 495-1000**

**Students**

Kathryn Hall

Graduate Studies

**Faculty**

Stephanie Parsons  
Jay Taft

School of Arts & Sciences  
School of Arts & Sciences

**IOWA STATE UNIVERSITY**  
**1605 Gilman**  
**Ames, IA 50011**  
**(515) 294-4111**

**Faculty**

Gordon Miller  
Krishna Vedula

Chemistry  
Materials Science & Engineering

Connie Hargrave

Ames Laboratory / DOE

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**  
**77 Massachusetts Avenue**  
**Cambridge, MA 02139**  
**(617) 253-1000**

**Students**

LaCreis Kidd  
Deirdre Lawrence  
Sandra Martin

Toxicology  
Toxicology  
Toxicology

**Faculty**

Edward H. Farhi  
George F. Foster  
Maurice S. Fox  
Robert J. Silbey  
William G. Thilly

Physics  
Physics  
Biology  
Chemistry  
Center for Environmental  
Health Sciences

Isaac Colbert  
Judy Jackson  
Mark Wrighton

Graduate School  
Office of Minority Education  
Provost

## PROGRAMME PARTICIPANTS

24

**NEW JERSEY INSTITUTE OF TECHNOLOGY**  
**323 High Street**  
**Newark, NJ 07102**  
**(201) 596-3000**

**Faculty**

Norman Loney

Chemical Engineering

**NORTH CAROLINA STATE UNIVERSITY**  
**Raleigh, NC 27695**  
**(919) 515-2011**

**Faculty**

Thoyd Melton

Graduate School

**OHIO STATE UNIVERSITY**  
**Columbus, OH 43210-1358**  
**(614) 292-6446**

**Faculty**

Greg Forest

Mathematics

**OREGON GRADUATE INSTITUTE OF SCIENCE AND TECHNOLOGY**  
**19600 NW Von Neumann Drive**  
**Beaverton, OR 97006**  
**(503) 690-1121**

**Faculty**

Marcia Fischer

**PRINCETON UNIVERSITY**  
**Princeton Township, NJ 08544**  
**(609) 258-3000**

**Faculty**

Steven Bernasek

Steven Greene

Rush Holt

Carlos Martinez Del Rio

Chemistry

Psychology

Plasma Physics Laboratory

Ecology and Environmental Biology

**TEXAS A&M UNIVERSITY**  
**College Station, TX 77843**  
**(409) 845-3211**

**Faculty**

Kenn Harding

Chemistry



## PROGRAMME PARTICIPANTS

25

**UNIVERSITY OF CALIFORNIA - DAVIS**  
**Davis, CA 95616**  
**(916) 752-1011**

**Students**

Donald Alcendor

Graduate Studies

**UNIVERSITY OF MINNESOTA**  
**Minneapolis, MN 55455**  
**(612) 625-5000**

**Faculty**

Jeffrey Roberts

Chemistry

**UNIVERSITY OF NOTRE DAME**  
**Notre Dame, IN 46556**  
**(219) 239-5000**

Roland Smith  
Frederick Wright

Office of the President

**UNIVERSITY OF SOUTH FLORIDA**  
**13501 Bruce B. Downs Boulevard**  
**Tampa, FL 33612**  
**(813) 974-6368**

**Faculty**

Joy O'Shields  
David Woodbridge

Minority Engineering Programs  
Environmental & Occupational Health

**UNIVERSITY OF TEXAS AT AUSTIN**  
**Austin, TX 78712**  
**(512) 471-3434**

**Faculty**

John Gilbert

**UNIVERSITY OF WISCONSIN AT MADISON**  
**500 Lincoln Drive**  
**Madison, WI 53706**  
**(608) 262-1234**

Paul Barrows

Graduate School

**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**  
**Blacksburg, VA 24061**  
**(703) 231-6738**

**Faculty**

James McGrath

Chemistry

## PROGRAMME PARTICIPANTS

26

### *Virginia Polytechnic Institute and State University (Continued)*

#### **Faculty**

Robert C. Bates

College of Arts & Sciences

Bevlee Watford

College of Arts & Sciences

#### **YALE UNIVERSITY**

**320 York Street**

**Box 15048**

**Yale Station**

**New Haven, CT 06520**

**(203) 432-2740**

Deborah G. Thomas

Graduate School

## PROGRAMME PARTICIPANTS

27

### FEDERAL AGENCIES AND NATIONAL LABORATORIES

#### ***AIR FORCE OFFICE OF SCIENTIFIC RESEARCH***

Dale Boland  
Air Force Office of Scientific Research  
(AFOSR/NI)  
Bolling Air Force Base  
Washington, DC 20332  
(202) 767-4969

#### ***AMES LABORATORY***

Tom Barton  
Ames Laboratory  
109 Office & Lab. Building  
Ames, IA 50011  
(515) 294-2770

#### **BATTELLE NORTHWEST LABORATORIES (PNL)**

Jack Bagley  
Battelle Northwest Laboratories  
3370 L'Enfant Promenade, SE  
Washington, DC 20024  
(202) 646-5255

Sheila Davidson  
Battelle Northwest Laboratories (PNL)  
P. O. Box 999  
MSIN K6-26  
Richland, WA 99352  
(509) 372-1297

Jim Falco  
Manager, Earth & Environmental Center  
Battelle Northwest Laboratories (PNL)  
P. O. Box 999  
MSIN K6-26  
Richland, WA 99352  
(509) 376-8432

Dan Pond  
Battelle Northwest Laboratories  
P. O. Box 999  
MSIN K6-26  
Richland, WA 99352  
(509) 372-1297

## **PROGRAMME PARTICIPANTS**

28

### ***JET PROPULSION LABORATORY***

Yvonne Freeman  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
Pasadena, CA 91109  
(818) 354-0725

Willis Meeks  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
MS 264-456  
Pasadena, CA 91109  
(818) 354-0725

Magalene Powell-Meeks  
Jet Propulsion Laboratory  
4800 Oak Grove Drive  
MS 125-177  
Pasadena, CA 91109  
(818) 354-0725

### ***LAWRENCE LIVERMORE NATIONAL LABORATORY***

Janet Benson  
Lawrence Livermore National Laboratory  
P. O. Box 808, L-793  
Livermore, CA 94551  
(510) 373-0284

### ***NATIONAL AERONAUTICS AND SPACE ADMINISTRATION***

Thomas Kashangaki  
NASA  
Code DSS-2  
Space Station Office  
10701 Parkridge Boulevard  
Reston, VA 22091-4398  
(703) 487-7616

Deborah Russell  
Program Manager  
Scholarships and Fellowships  
Minority University Research & Education  
NASA Headquarters  
Code EU  
Washington, DC 20546  
(202) 358-0935

## **PROGRAMME PARTICIPANTS**

29

### ***National Aeronautics and Space Administration (Continued)***

Philip Sakimoto  
Goddard Space Flight Center  
NASA/GSFC Code 160  
Greenbelt, MD 20771  
(301) 286-8733 or (301) 286-2000

Mildred Wyatt  
Office of University Programs  
Goddard Space Flight Center  
NASA/GSFC Code 160  
Greenbelt, MD 20771  
(301) 286-8733 or (301) 286-2000

### ***OFFICE OF NAVAL RESEARCH***

Harold Guard  
Chemistry Division  
Office of Naval Research  
800 North Quincy Street  
Arlington, VA 22217-5000  
(202) 696-4409

### ***SANDIA NATIONAL LABORATORIES***

Arthur Morales  
Sandia National Laboratories  
P. O. Box 5800  
Albuquerque, NM 87185  
(505) 845-9765

Eunice Young  
Sandia National Laboratories  
P. O. Box 5800  
Organization 35B  
Albuquerque, NM 87185  
P. O. Box 5800  
(505) 845-9766

### ***STRATEGIC DEFENSE INITIATIVES ORGANIZATION***

Stephen M. Moss  
Strategic Defense Initiatives Organization  
Small And Disadvantaged Business Utilization (SADBU)  
SDIO/SB The Pentagon  
Washington, DC 20301-7100  
(703) 693-1553

## **PROGRAMME PARTICIPANTS**

30

### ***TUFTS UNIVERSITY/U.S. EPA***

Kate McDaniel  
Tufts University/U.S. EPA  
c/o 960 College Station Road  
Athens, GA 30605  
(706) 546-3524

Ida Rosario-Heber  
Tufts University/U.S. EPA  
c/o 960 College Station Road  
Athens, GA 30605  
(706) 546-3524

### ***UNITED STATES ARMY***

Clinton Brown  
U.S. Army CECOM  
Center for EW/RSTA  
Fort Monmouth, NJ 07703  
(908) 544-3222

### ***UNITED STATES DEPARTMENT OF ENERGY***

John Crockett  
Oak Ridge Institute for Science and Education  
P. O. Box 117  
Oak Ridge, TN 37831  
(615) 576-3253

Barry Goldman  
Oak Ridge Institute for Science and Education  
P. O. Box 117  
Oak Ridge, TN 37831  
(615) 576-2310

Larry Thompson  
U.S. Department of Energy  
9800 S. Cass Avenue  
Argonne, IL 60439  
(708) 252-2711

## PROGRAMME PARTICIPANTS

31

### ORGANIZATIONS

#### ***ASSOCIATED WESTERN UNIVERSITIES***

Joan Miller  
Associated Western Universities  
4190 South Highland Drive  
Salt Lake, UT 84124  
(801) 278-0799

#### ***THE BERKELEY INSTITUTE***

Jennifer Ellison  
Darrin Visarraga

#### ***FUTRON CORPORATION***

Maggie Manning  
Education Division  
7315 Wisconsin Avenue  
Suite 400W  
Bethesda, MD 20814-3202  
(301) 907-7109

#### ***MARTIN MARIETTA ENERGY SYSTEMS, INC.***

W. Mamie Johnson  
Martin Marietta Energy Systems, Inc.  
105 Mitchell Road, MS 6496  
Oak Ridge, TN 37831

#### ***NATIONAL CONSORTIUM - GEM***

Howard Adams  
National Consortium - GEM  
P. O. Box 537  
Notre Dame, IN 46556

#### ***RESEARCH AND DEVELOPMENT LABORATORIES***

Billy Kelley  
5800 Uplander Way  
Culver City, CA 90230  
(800) 677-1363

## PROGRAMME PARTICIPANTS

32

### ***SCEEE***

Warren D. Peele  
1101 Mass. Avenue  
St. Cloud, FL 34769  
(407) 892-6416

### ***SHELADIA ASSOCIATES, INC.***

Tawanna Chelsey  
15825 Shady Grove Road  
Suite 100  
Rockville, MD 20850  
(301) 258-7474







# **APPENDIX 8**

## **HiPPAC Seminar Announcements**

ORIGINAL PAGE  
COLOR PHOTOGRAPH

PAGE 1



# HiPPAC Center Seminar Series

"Holographic Interferometry in the Non-Destructive  
Evaluation of Ceramics"

by

Dr. B. Rhodes (CAU)

and

"Polyimide Curing by Diels-Alder Cycloaddition"

by

Dr. L. Tolbert (Georgia Tech)

|        |                         |
|--------|-------------------------|
| DATE:  | Thursday, March 5, 1992 |
| TIME:  | 4:00 p.m.               |
| PLACE: | 310 Text & Fiber Eng    |

GEORGIA TECH CAMPUS



# CAU - GA TECH

## HiPPAC Center Seminar Series

"Silicon-Acetylene Polymers as Preceramic,  
Electrically-Conducting and NLO Materials"

by

Dr. Thomas J. Barton  
Professor of Chemistry, and  
Director, Ames Laboratory  
Iowa State University

|        |                        |
|--------|------------------------|
| DATE:  | Monday, April 13, 1992 |
| TIME:  | 4:00 p.m.              |
| PLACE: | 301C Haven-Warren      |

CAU CAMPUS





# CAU - GA TECH HiPPAC Center Seminar Series

"Applications of Infrared Diffuse  
Reflectance Spectroscopy"

by

Dr. M. Mitchell (CAU)

and

"Pretreatment and Pyrolysis of  
Polyorganosilazane Polymers"

by

Dr. P. Desai (Georgia Tech)

|        |                       |
|--------|-----------------------|
| DATE:  | Thursday, May 7, 1992 |
| TIME:  | 4:00 p.m.             |
| PLACE: | 310 Text & Fiber Eng  |

GEORGIA TECH CAMPUS



# CAU - GA TECH HiPPAC Center Seminar Series

"Recent Research on High Performance  
Filamentary Materials"

by

Dr. A.S. Abhiraman  
Professor, Chem. Eng., and  
Director, Polymer Education and  
Research Center (Ga Tech)

|        |                         |
|--------|-------------------------|
| DATE:  | Wednesday, June 3, 1992 |
| TIME:  | 4:00 p.m.               |
| PLACE: | 102 Wright Hall         |

CAU CAMPUS



# CAU - GA TECH HiPPAC Center Seminar Series

"Polyimide Composites by  
Powder Prepregging"

by

Dr. J. Muzzy (Ga Tech)

and

"Measurement of Refractive Index of  
Polymer Films using an Abbe Refractometer"

by

Dr. S. Moghazy (CAU)

|        |                        |
|--------|------------------------|
| DATE:  | Thursday, July 9, 1992 |
| TIME:  | 4:00 p.m.              |
| PLACE: | 310 Text & Fiber Eng   |

GEORGIA TECH CAMPUS



# **CAU - GA TECH HiPPAC Center Seminar Series**

**"Experimental and Theoretical Study  
of Succinonitrile-Water System"**

by

**Dr. S. Bhatia (Spelman)**

and

**"Evaluation of Hardness and Fracture Toughness  
of Sol-Gel Derived Ceramics and Ceramic Composites"**

by

**Dr. O. Sowemimo (CAU)**

|               |                                  |
|---------------|----------------------------------|
| <b>DATE:</b>  | <b>Wednesday, August 5, 1992</b> |
| <b>TIME:</b>  | <b>4:00 p.m.</b>                 |
| <b>PLACE:</b> | <b>102 Wright Hall</b>           |

**CAU CAMPUS**





# CAU - GA TECH HiPPAC Center Seminar Series

"Rearrangement Reactions of  $\alpha$ -Allenic Sulfoxides"

*by*

*Dr. A. Rodriguez (CAU)*

*and*

"Star-Like Liquid Crystal Polymers"

*by*

*Dr. M. Polk (Ga Tech)*

|        |                             |
|--------|-----------------------------|
| DATE:  | Thursday, September 3, 1992 |
| TIME:  | 4:00 P.m.                   |
| PLACE: | 310 Text & Fiber Eng        |

GEORGIA TECH CAMPUS



# **APPENDIX 9**

## **Agenda and Minutes of Advisory Committee Meetings**

ORIGINAL PAGE  
COLOR PHOTOGRAPH  
PAGE.





Institute for Physical Research and Technology

Iowa State University / Ames, Iowa 50011-3020

September 30, 1992

Dr. Eric A. Mintz  
Director, HiPPAC Center  
Clark Atlanta University  
James P. Brawley Drive at Fair Street, S.W.  
Atlanta, GA 30314

Dear Eric:

Here is what I imagine is the final form of the review of the first External Advisory Committee. There are no surprises as it is essentially the same as the draft sent earlier by Professor McGrath with your corrections and additions included along with some minor Bartonesque changes.

I look forward to seeing you on October 16.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Tom", written in dark ink.

Thomas J. Barton  
Director, Ames Laboratory  
Distinguished Professor of Chemistry

TJB:kh

cc: Dr. James McGrath  
Dr. Kofi B. Bota



**First Meeting of the External Advisory Committee for the High  
Performance Polymers and Ceramics (HiPPAC) Center  
Clark Atlanta University**

**July 26-27, 1992**

A High Performance Polymer and Ceramics Center has been established at Clark Atlanta University (CAU) with NASA operational funding, including principal investigators from CAU, Georgia Tech, Morris Brown and Spelman. The disciplines covered include Chemistry, Chemical Engineering, Physics and Textile & Fiber Engineering. A list of the investigators is enclosed as Table 1. The CAU HiPPAC Center has assembled a number of people from academia and industry to serve on their External Advisory Committee and a list of these individuals is provided in Table 2. At the first External Advisory Committee meeting everyone shown was in attendance with the exception of Prof. Eisenberg, Prof. Lenz and Dr. Ragu. The agenda for the meeting is shown in Table 3, and included an informal meeting on Sunday evening, July 26, and a full day of important discussions on Monday, July 27. After presentations by Profs. Mintz, Moeti and Bota, a tour of the partially completed new research building was provided, followed by an informative poster session on the areas of research interest of HiPPAC potential participants. The Committee meeting was conducted during the afternoon period, both in closed and open session.

The introductory comments by Prof. Mintz focused on the issue of the establishment of important Centers in historically black colleges and universities (HBCU's), and particularly CAU. The development of CAU after the merger of Atlanta University with Clark College was reviewed by Prof. Bota. This represented a merging of a strong graduate program with a strong undergraduate program to produce the current university. A major objective of the university is to develop a strong program which will graduate approximately 100 science and mathematics students per year, who would be qualified to attend graduate schools at leading universities in the United States. In addition, the graduate program at CAU would be effectively able to generate a number of advanced degrees (M.S. and Ph.D.) with a considerable focus on those undergraduates who have received their degrees at other HBCU's. A related goal would be to develop Clark Atlanta University as a leading polymer and ceramics center. Standards will include student development, faculty development and, in particular, infrastructure development. The main focus during the first year will be to develop the infrastructure. An impressive research center is being constructed and major emphasis over the first year will be to complete this research center and to equip it to the stage where effective, state of the art research can be conducted. The HiPPAC Center is funded by NASA (who have now established seven such Centers) and said funding is programmed for five years. There will be an annual review in October, 1992, and after the third year there will be a critical technical review. In principle, the Center is established as a ten year program which will focus on developing the capabilities of HBCU's in education and research. Prof Bota





pointed out that several other centers have either been already established at CAU or will soon be established as a part of this overall research thrust. These include an aerospace structures effort funded through Wright Patterson Air Force Base; software development through the ONR; environmental studies through the EPA; theoretical physics and chemistry efforts by NSF; and possibly some energetics and aerosols research via the Army Chemical Research and Development Center at the Aberdeen Proving Grounds.

Prof. Moeti summarized some of the research programs, emphasizing those which would particularly focus on polyimides for high-temperature organic materials applications, as well as ceramics for even higher temperature utilization. Twenty-one investigators have been proposed at this point. Prof. Bota emphasized that after the infrastructure is complete (mainly done in the first year, but never totally completed!) that the time will have arrived to deliver both good students and high quality research, and this was the challenge given to the Advisory Committee - to provide an honest yet sophisticated analysis of the proposed initial directions and overall plan.

Prof. Tom Barton from the Ames Laboratory (USDOE) and the Chemistry Department of Iowa State University and Prof. James McGrath from the Chemistry Department and NSF Center at Virginia Polytechnic Institute and State University were charged with responsibility for drafting the first report of the Advisory Committee. The co-chairs communicated the representative views of the Advisory Committee during the last hour of the meeting. In essence, the goal is to improve HBCU's, specifically CAU, by establishing CAU as a recognized academic leader in polymer and ceramic science. The emphasis will be on generating strong undergraduate students capable of competing effectively in graduate school at the top twenty-five research universities in the United States. A second important goal will be to establish facilities where graduate research can be pursued by graduates from other HBCU's. The Advisory Committee emphasized the need for complimentary funding to be obtained through normal competitive processes by the faculty. Ultimately the success of this endeavor will be measured by the number of refereed publications in established journals, contributed and invited presentations at national scientific meetings, and the success of the students trained in the HiPPAC Center. This latter measure will require a program of tracking students as they proceed in Ph.D. programs elsewhere. A definitive plan for internal/external review of each funded research project needs to be defined.

It was strongly felt that the CAU HiPPAC should develop a "vision statement" which defines the goals and major thrusts. This is needed immediately for guidance of participating faculty. Another recommendation was that critical issues be defined which can allow for an interplay with the faculty expertise that exists at CAU. The Committee was concerned that number of potential PI's and co-PI's was far too many for the funds available from NASA. The Committee suggested an internal competition requiring a three-year vision statement encompassing research and student training be held to reduce the number of investigators to maximize the effective use of funds. Along these lines there was some discussion about the status of the faculty and the



question was raised as to whether they were prepared to immediately develop research programs which could be viewed as first rate, or if not, what should be done to try to improve their capabilities so that this can be achieved. The conclusion was that collaboration in the early years will be very critical. Georgia Tech faculty are also involved and can certainly help significantly in the early development. In addition, members of the Advisory Committee offered help in terms of summer programs, visiting faculty, collaborative research, etc. The development of joint projects between other universities and national labs with CAU, particularly those projects which can obtain industrial funding, was recommended as a desirable approach for the CAU faculty. Collaboration will be particularly crucial until the new research facility is complete and operational. The Committee agrees with Prof. Bota that infrastructure is the first critical objective that must be completed. Fortunately, the funding agencies appear to agree with this approach. However definitive research plans must be made now and research must be initiated as soon as possible via collaborative efforts if HiPPAC is to be able to show real progress toward it's goals by the time of a third-year review.

The External Advisory Committee concluded its discussions and agreed to meet again on October 26-27 in Atlanta.



**First Meeting of the External Advisory Committee for the  
High Performance Polymers and Ceramics (HiPPAC) Center,  
Clark Atlanta University  
July 26 - 27, 1992**

A High Performance Polymer and Ceramics Center has been established at Clark Atlanta University under NASA funding, including principal investigators from Clark Atlanta University, Georgia Tech, Morris Brown and Spelman. The disciplines covered include Chemistry, Chemical Engineering, Physics and Textile and Fiber Engineering. A list of the investigators is enclosed as Table 1. The Clark Atlanta University HiPPAC Center has assembled a number of people from academia and industry to serve on their External Advisory Committee. A list of these individuals is provided in Table 2. At the first External Advisory Committee meeting, everyone shown was in attendance with the exception of Prof. Eisenberg, Prof. Lenz and Dr. Ragu. The agenda for the meeting is shown in Table 3, and included an informal meeting on Sunday evening, July 26, and a rather full day of important discussions on Monday, July 27. After reviews by Prof. Mintz, Prof. Moeti and Prof. Bota, a tour of the new research Center was provided, followed by a poster session on current research interests of HiPPAC participants. The External Advisory Committee meeting was conducted during the afternoon period, both in closed and open session.

The introductory comments by Prof. Mintz focused on the issue of the establishment of important Centers in historically black colleges and universities (HBCU's), and particularly at Clark Atlanta University. The development of Clark Atlanta University after the merger of Atlanta University with Clark College was reviewed by Prof. Bota. This represented a merging of a strong graduate program with a strong undergraduate program to produce the current university. A major objective of the university is to develop a strong program which will graduate approximately 100 students per year, who would be qualified to attend graduate schools at leading universities in the United States. In addition, the graduate program at Clark Atlanta



would be effectively able to generate a number of advanced degrees (M.S. and Ph.D.) with a considerable focus on those undergraduates who have received their degrees at other HBCU's. A related goal would be to develop Clark Atlanta University as a mainstream polymer and ceramics center. Standards will include student development, faculty development and, in particular, infrastructure development. The main focus during the first year will in fact be to develop the infrastructure. An impressive research center has been built and major emphasis over the first year will be to complete this research center (which was toured by the Advisory group) and to enable it to reach the stage where effective research can be conducted.

The HiPPAC Center is funded by NASA (who have now established seven such Centers) and is programmed for five years. There will be an annual review in October, 1992 and the third year will have a critical technical review. In principle, the Center is established as a ten year program, which will focus on developing the capabilities of HBCU's in education and research. Prof. Bota pointed out that several other centers have either been established already at Clark Atlanta or will be shortly established as a part of this overall research thrust. These include an aerospace structures effort, funded through Wright Patterson Air Force Base; software development through the ONR; environmental studies through the EPA; theoretical physics and chemistry efforts by NSF; and possibly, some energetics research via the Army Chemical Research and Development Center at Aberdeen Proving Ground..

Prof. Mintz summarized some of the research purposes, emphasizing those which would particularly focus on polyimides for high temperature organic materials applications, as well as ceramics for even higher temperature utilization. Twenty-one investigators are envisioned at this point. Prof. Bota emphasized that after the infrastructure is complete that the time will have arrived to deliver both good students

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and good research and this was the challenge given to the Advisory Committee--to provide an honest and yet sophisticated analysis of the proposed initial directions.

Prof. Tom Barton from the Ames Laboratory at Iowa State and Prof. James McGrath from the Chemistry Department and NSF Center at Virginia Polytechnic Institute and State University were charged with responsibility for drafting the first write-up of the Advisory Committee. The co-chairs communicated the representative views of the Advisory Committee during the last hour of the meeting. In essence, the goal of the HBCU's, and specifically Clark Atlanta University (CAU), will in fact be to develop the infrastructure, students and faculty to allow CAU to become a mainstream polymer and ceramics center. The emphasis will be on generating strong undergraduate students capable of competing effectively in graduate school at the top twenty-five research universities in the United States. A second and important goal will be to establish facilities where graduate research can be pursued by undergraduate degree recipients from other HBCU's. A third and equally important issue raised by the External Advisory Committee was the large number of PI's and Co-PI's based on the funds available. The Committee felt that an internal competition would be desirable to reduce the number of investigators to maximize the use of funds available and start-up or seed funding should be made available for junior faculty, investigators changing from teaching to research, and investigators pursuing new areas of research. In addition, the External Advisory Committee also recommended that a three year vision statement be prepared by each investigator in formulating the basis for internal competition of funds. This vision statement should encompass research, teaching, student training, and service. It was felt that this should be done as soon as possible. The Advisory Committee emphasized the need for complementary funding by the faculty and the desirability of producing a significant number of refereed publications in established journals, along with appropriate contributed and invited



presentations at national scientific meetings, such as the American Chemical Society, American Institute of Chemical Engineers, The Society of Plastics Engineers, etc.

It is suggested that the CAU HiPPAC develop a short vision statement which attempts to define the major thrusts that it wishes to establish. This is needed very soon, for guidance of participating faculty. Another recommendation was that critical issues be defined which can allow for an interplay with the faculty expertise that exists at CAU. Along these lines, there was some discussion about the status of the faculty and the question was raised as to whether they will be able to immediately develop research programs which will be recognized as first rate, or if not, what should be done to try to improve their capabilities so that this can be achieved. The conclusion was that collaboration in the early years will be very critical. Georgia Tech faculty are also involved and can certainly help significantly in the early development. In addition, members of the External Advisory Committee all offered their help in terms of summer programs, visiting faculty, collaborative research, etc. The development of joint projects between other universities with CAU, and particularly those projects which could be partially industrially funded, was definitely recommended as a desirable approach for the CAU faculty. Finally, further definition of the "core" areas of the HiPPAC Center was recommended. The External Advisory Committee's initial view of the research projects suggested was that while they are very impressive in terms of their scope, they are likely too broad to be readily tackled at this time. The Committee definitely agrees with the approach suggested by Prof. Bota that infrastructure is the first critical objective that must be completed. Fortunately, the funding agencies appear to agree with this assessment.

The Committee concluded its discussions and agreed to meet again on October 26 - 27 in Atlanta.



**Table 1**

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**High Performance Polymer and Ceramics  
(HiPPAC) Center  
at  
Clark Atlanta University**

**INVESTIGATORS**

| <b>Name</b>         | <b>Institutional<br/>Affiliation<br/>and Discipline</b> | <b>Designation</b> | <b>Phone<br/>Number<br/>(404)</b> |
|---------------------|---|--------------------|-----------------------------------|
| E. Mintz            | CAU (Chemistry)   | Director           | 880-8589                          |
| L. Moeti            | CAU (Chem Eng)  | Assoc. Director    | 880-8592                          |
| A. Abhiraman        | Ga Tech (Chem Eng)                                      | Co-PI              | 894-2874                          |
| S. Bhatia           | Spelman (Chemistry)                                     | PI                 | 523-5153                          |
| B. Cardelino        | Spelman (Chemistry)                                     | PI                 | 523-5148                          |
| D. Collard          | Ga Tech (Chemistry)                                     | Co-PI              | 894-4026                          |
| P. Desai            | Ga Tech (T&F Eng)                                       | Co-PI              | 894-8341                          |
| I. Harruna          | Morris Brown (Chem)                                     | Co-PI              | 220-0175                          |
| I. Khan             | CAU (Chemistry)   | PI                 | 880-8583                          |
| Y. Mariam           | CAU (Chemistry)   | PI                 | 880-8593                          |
| T. Mensah           | CAU (Chem Eng)  | PI                 | 880-8013                          |
| M. Mitchell         | CAU (Chemistry)   | PI                 | 880-8314                          |
| S. Moghazy          | CAU (Physics)   | PI                 | 880-8216                          |
| C. Moore            | NASA-MSFC (Chem)  | Co-PI              |                                   |
| J. Muzzy            | Ga Tech (Chem Eng)                                      | Co-PI              | 894-2882                          |
| C. Parker           | CAU (Chemistry)   | PI                 | 880-8967                          |
| C. Papageorgopoulos | CAU (Physics)   | Co-PI              |                                   |
| M. Polk             | Ga Tech (T&F Eng)                                       | Co-PI              | 894-2535                          |
| J. Reed             | CAU (Chemistry)   | PI                 | 880-8587                          |
| A. Rodriguez        | CAU (Chemistry)   | PI                 | 880-8750                          |
| R. Samuels          | Ga Tech (Chem Eng)                                      | Co-PI              | 894-2885                          |
| O. Sowemimo         | CAU (Physics)   | PI                 | 880-8216                          |
| L. Tolbert          | Ga Tech (Chemistry)                                     | Co-PI              | 894-4043                          |

T & F Eng = Textile & Fiber Engineering

C-4



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**Table 2**  
**External Advisory Committee**  
*for*  
**HiPPAC Center**  
*at*  
**Clark Atlanta University**

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| <b>Name</b>            |   | <b>Affiliation</b>                                      |
|------------------------|---|---|
| Tom Barton             | - | Ames Laboratory/Iowa State University                   |
| George Collins         | - | Hoechst Celanese<br>Robert L. Mitchell Technical Center |
| Adi Eisenberg          | - | McGill University                                       |
| Victoria M. Franchetti | - | Monsanto Chemical Company                               |
| Don Hylton             | - | EXXON Chemical Company                                  |
| Tony Jackson           | - | Lockheed Aeronautical Systems Co.                       |
| Robert Lenz            | - | University of Massachusetts                             |
| James McGrath          | - | Virginia Polytechnic and State University               |
| Gary Poehlein          | - | Georgia Institute of Technology                         |
| Chris Ragu             | - | Amoco Performance Products                              |
| Dietmar Seyferth       | - | Massachusetts Institute of Technology                   |
| D.Y. Sogah             | - | Baker Laboratory/Cornell University                     |

Representative from: DuPont  
Prairie View A&M University





Table 3

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**Clark Atlanta University**  
**High Performance Polymers and Ceramics**  
**External Advisory Committee Meeting**  
**July 26-27, 1992**

**AGENDA**

*Sunday, July 26, 1992*

- 6:00 p.m.     -     Reception
- 7:00 p.m.     -     Informal Dinner - External Advisory Committee,  
Observers, Director, Associate Director, V.P. for  
Research and Sponsored Programs, HiPPAC  
Investigators, Jarrett Room, Omni Hotel

*Monday, July 27, 1992*  
*Clark Atlanta University*  
*Haven Warren, Room 301C*

- 9:00 a.m.     -     Introduction, Eric A. Mintz, Ph.D.
- 9:10 a.m.     -     Dr. Thomas W. Cole, Jr., President
- 9:20 a.m.     -     Presentations on Program Components
- 10:00 a.m.     -     Tour of the Research Center
- 10: 30 a.m.     -     Poster Session, McPheeter-Dennis Hall, 2nd Floor
- 12:00 Noon     -     LUNCH (Internal and External Advisory Committee)
- 1:00 p.m.     -     External and Internal Advisory Committee Meeting
- 2:15 p.m.     -     BREAK
- 2:30 p.m.     -     External Advisory Committee (Assessment)
- 3:30 p.m.     -     External and Internal Advisory Committee Reconvene
- 4:30 p.m.     -     Meeting Adjourns



## **APPENDIX 10**

**HiPPAC Fellowship Application Contract,**

**Sample Tracking Screens, etc**

ORIGINAL PAGE  
~~COLOR PHOTOGRAPH~~  
PAGE.



\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Dear \_\_\_\_\_

We are pleased to offer you a one year undergraduate fellowship in Clark Atlanta University's NASA-HiPPAC (High Performance Polymers and Ceramics) Program which is renewable on a year-to-year basis subject to your performance and availability of funds. You are to be congratulated on being selected from a list of excellent candidates. A form detailing conditions attendant to the NASA-HiPPAC research fellowship is enclosed. Please note that one of the requirements is that you major in Chemistry, Physics, or the Dual Degree Engineering Program and carry out undergraduate research in materials science with a HiPPAC Investigator, (See attached list.) In addition, a NASA-HiPPAC research contract is enclosed for you to complete. Please take a few minutes to read and understand the forms enclosed before completing them. If you have any questions in this regard, please feel free to contact me at the following address and phone number:

Dr. Eric A. Mintz  
Director, HiPPAC Center  
Clark Atlanta University  
223 James P. Brawley Dr. S.W.  
Atlanta, GA 30314-4391

(404) 880-8589 (call collect)

Clark Atlanta University is very proud to have an individual with your credentials and aptitude as a member of its student body. Again, congratulations and we look forward to hearing from you.

Sincerely,

Eric A. Mintz, Ph.D.  
Director, HiPPAC Center

Enclosures

Sincerely,

Lebone T. Moeti, Ph.D.  
Associate Director,  
HiPPAC Center



**CONDITIONS ATTENDING TO  
THE NASA-HiPPAC RESEARCH FELLOWSHIP**

1. NASA-HiPPAC Fellows are required to devote full-time to the prescribed academic pursuits in the program. The NASA-HiPPAC Scholar shall at no time during the tenure of this fellowship be employed either full or part-time in any other pursuit. To do so invites revocation of the fellowship.
2. The NASA-HiPPAC Scholar must maintain a minimum of 3.00 GPA and major in chemistry, physics, or the dual degree engineering program to retain their fellowship. Warnings will be given during the middle of each academic year if problems arise, and a rigorous evaluation will be made at the end of each academic year.
3. The rules of conduct are the same as those established by the University in general. This office makes no additional rules in this regard. Should the University at any time find the student in serious difficulty regarding its published rules, this office will then consider dismissal on the same grounds.
4. The academic schedule which the students must adopt is determined by the department in which he/she studies and this schedule is subject to the approval of the NASA-HiPPAC Office.
5. The NASA-HiPPAC Fellows are required to attend and fully participate in all extra-curricular activities planned for these fellows by the NASA-HiPPAC Office which will include working 2 hours per week in CAU's Pre-College Outreach Program. Other activities may include banquets, extra lectures by outstanding fellows, picnics, etc., and other group activities.
6. The NASA-HiPPAC Fellows are expected to attend such extra sessions of an academic nature which may be attendant to any and all courses in which he/she may be enrolled.
7. After the freshman year, NASA HiPPAC Research Fellows will be required to conduct research with a HiPPAC Investigator (see attached list) for a minimum of 10 hours per week during the academic year.
8. Fellowship support is based on estimated costs of attending Clark Atlanta University for an undergraduate student:

Tuition for one year (1992-1993)  
Dormitory Fees for one year (1992-1993)  
Full meal plan in the dining hall of the University (1992-1993)  
Estimated costs for books and supplies for the  
1992-1993 academic year - Maximum of \$600.00  
Stipend for incidental expenses for the 1992-1993 academic year - \$200

9. Fellowships at Clark Atlanta University are designed to allow students to attend the University without concern about how their bills will be paid. NASA-HiPPAC Fellows who receive fellowship support in addition to the NASA-HiPPAC Fellowship will be eligible for refunds according to established University guidelines. PELL Grants, Georgia Tuition Equalization Grants, and other Federal or state grants are exempt from refund consideration and will be applied in place of NASA-HiPPAC funds.





## NASA-HiPPAC RESEARCH CONTRACT

AS A NASA-HiPPAC FELLOWSHIP RECIPIENT, I UNDERSTAND THAT:

1. Tuition, dormitory fees, and food costs will be paid directly to the University on my behalf.
2. As a NASA-HiPPAC Fellowship recipient I will receive a book voucher for a maximum of \$600 per year to assist in purchasing books. All other book costs above \$600 will be my responsibility.
3. All NASA-HiPPAC Fellows are required to report to the Director of the Program all fellowships and grants received in addition to the NASA-HiPPAC Fellowship. I further understand that this is a requirement of the NASA-HiPPAC funding agency (National Aeronautics and Space Administration) and failure to comply will result in cancellation of the NASA-HiPPAC Fellowship.

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If you have read, understand, and agree with the conditions of the NASA-HiPPAC Contract and the NASA-HiPPAC Fellowship Award Letter, please affix your signature and return this form by June 30, 1992. Keep a copy for your files.

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Dear Sirs:

I have read and understand the Conditions Attending to the NASA-HiPPAC Research Fellowship and pledge to comply with the conditions as outlined.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

I have read the Letter of Grant Award and the conditions pertaining to accepting this fellowship award. I accept the fellowship award.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

I am declining the Grant Award

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date



**CLARK ATLANTA UNIVERSITY**  
**CENTER FOR HIGH PERFORMANCE POLYMERS AND CERAMICS**  
James P. Brawley Drive at Fair Street, S. W., Atlanta, Georgia 30314 (404) 880-8000

**Application**

Directions: Please print or type all information.

1. NAME \_\_\_\_\_  
Last First M.I.
2. Social Security Number \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ Female \_\_\_\_\_ Male \_\_\_\_\_
3. Current Address \_\_\_\_\_  
Street Number/Name Apt. No.
4. City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ County \_\_\_\_\_
5. Area Code \_\_\_\_\_ Home Telephone Number \_\_\_\_\_
6. Date of Birth \_\_\_\_\_
7. How do you identify Yourself?  
\_\_\_\_\_ Asian American \_\_\_\_\_ Native American  
\_\_\_\_\_ African American \_\_\_\_\_ Hispanic  
\_\_\_\_\_ White American \_\_\_\_\_ Other (Please Specify)
8. Father's Name \_\_\_\_\_  
Last First
9. Mother's Name \_\_\_\_\_  
Last First
10. Parents Address \_\_\_\_\_  
Street Number/Name
11. City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_
12. Parents Home Telephone Number \_\_\_\_\_
13. Father's Occupation \_\_\_\_\_ 14. Work/Office Telephone  
Number \_\_\_\_\_
15. Mother's Occupation \_\_\_\_\_ 16. Work/Office Telephone  
Number \_\_\_\_\_
17. Name of your high School \_\_\_\_\_ Public \_\_\_\_\_ Private \_\_\_\_\_



18. School Address \_\_\_\_\_  
Street Number/Name

19. City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ County \_\_\_\_\_

20. Name of Counselor \_\_\_\_\_ Telephone Number \_\_\_\_\_

What is your current GPA? \_\_\_\_\_ 22. SAT Scores: Verbal \_\_\_\_\_ Math \_\_\_\_\_

ACT Score \_\_\_\_\_ 24. PSAT Scores: Verbal \_\_\_\_\_ Math \_\_\_\_\_

If you have not taken the SAT or ACT, when will you take it? \_\_\_\_\_

Your intended major (check one):

\_\_\_\_\_ Chemistry \_\_\_\_\_ Computer Science \_\_\_\_\_ Mathematics \_\_\_\_\_ Physics

List all science, mathematics, and computer science courses you have taken and the grades earned in each course. (Use additional sheets, if necessary)

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

List in chronological order, awards or honors you have received since the 9th grade (use additional sheets, if necessary).

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

List your present or former leadership positions, interests, hobbies, community service projects, and other extracurricular activities. (Use additional sheets if necessary).

|       |
|-------|
| _____ |
| _____ |
| _____ |
| _____ |



List any previous academic enrichment programs in which you have participated. Be sure to indicate dates and locations. (Use additional sheets if necessary.)

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

31. Have you applied to Clark Atlanta University for the 1991-92 school year?  
\_\_\_ Yes      \_\_\_ No

\_\_\_\_\_

I certify that the information listed in this application is correct to the best of my knowledge.

\_\_\_\_\_

Applicant Signature

\_\_\_\_\_

Date

\*\*\*\*\*

In addition to the information already requested, please be sure to do the following:

1. On a separate sheet, write an essay of approximately 500 words explaining what your career goal is and how the Clark Atlanta University High Performance Polymers and Ceramics Center will assist you in reaching your goal.
2. Request two of your teachers (science and mathematics) to complete and mail recommendation forms for you. List the names of these teachers in spaces provided.

Name \_\_\_\_\_ Position \_\_\_\_\_

Name \_\_\_\_\_ Position \_\_\_\_\_

3. Please include a copy of your high school transcript with this application form, or request that your counselor send one to the address below.

\_\_\_\_\_

Return To:

Dr. Eric A. Mintz  
Director, HiPPAC Center  
Clark Atlanta University  
James P. Brawley Drive at Fair Street, S.W.  
Atlanta, GA 30314





## This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



**BACHELOR OF SCIENCE IN CHEMISTRY  
HIPAC FELLOW GRADE TRACKING FORM**

Student Name: \_\_\_\_\_ Social Security Number: \_\_\_\_\_

| <p><b>Freshman Year (First Semester), 17 Hrs.</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%; text-align: center;">GRADE</th> <th style="width: 30%; text-align: center;">SEMESTER</th> </tr> </thead> <tbody> <tr><td>CHE 111</td><td>_____</td><td>_____</td></tr> <tr><td>GED 100</td><td>_____</td><td>_____</td></tr> <tr><td>GED 105</td><td>_____</td><td>_____</td></tr> <tr><td>GED 211</td><td>_____</td><td>_____</td></tr> <tr><td>GED 101</td><td>_____</td><td>_____</td></tr> <tr><td>MAT 105</td><td>_____</td><td>_____</td></tr> <tr><td>PED 101</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> </tbody> </table> <p>SEM. CR. HRS. _____ SEM. GPA _____</p> |       | GRADE    | SEMESTER | CHE 111 | _____ | _____ | GED 100 | _____ | _____ | GED 105    | _____ | _____ | GED 211  | _____ | _____ | GED 101    | _____ | _____ | MAT 105  | _____ | _____ | PED 101   | _____ | _____ | Elective   | _____   | _____ | Elective | _____   | _____ | <p><b>Freshman Year (Second Semester), 16 Hrs.</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%; text-align: center;">GRADE</th> <th style="width: 30%; text-align: center;">SEMESTER</th> </tr> </thead> <tbody> <tr><td>CHE 112</td><td>_____</td><td>_____</td></tr> <tr><td>GED 100</td><td>_____</td><td>_____</td></tr> <tr><td>GED 101</td><td>_____</td><td>_____</td></tr> <tr><td>GED 106</td><td>_____</td><td>_____</td></tr> <tr><td>GED 212</td><td>_____</td><td>_____</td></tr> <tr><td>MAT 106</td><td>_____</td><td>_____</td></tr> <tr><td>PED 102</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> </tbody> </table> <p>SEM. CR. HRS. _____ SEM. GPA _____</p> |         | GRADE | SEMESTER | CHE 112 | _____ | _____ | GED 100 | _____ | _____ | GED 101  | _____ | _____ | GED 106  | _____ | _____ | GED 212  | _____ | _____ | MAT 106  | _____ | _____ | PED 102 | _____ | _____ | Elective | _____ | _____ | Elective | _____ | _____ |
|--|-------|----------|----------|---------|-------|-------|---------|-------|-------|------------|-------|-------|----------|-------|-------|------------|-------|-------|----------|-------|-------|---|-------|-------|--|---------|-------|----------|---------|-------|---|---------|-------|----------|---------|-------|-------|---------|-------|-------|----------|-------|-------|----------|-------|-------|----------|-------|-------|----------|-------|-------|---------|-------|-------|----------|-------|-------|----------|-------|-------|
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 111  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 100  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 105  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 211  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 101  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 105  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| PED 101  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 112  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 100  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 101  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 106  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| GED 212  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 106  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| PED 102  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
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|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| BIO 111  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 211  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| ENG 201  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 111  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| F. LANG.   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| BIO 112  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 212  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| ENG 202  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 112  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| F. LANG.   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
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|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 231  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 211  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| PHY 111  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| PSY 211  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Humanities   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 232  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| HIS 205  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| or   |       |          |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| SOS 205  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| MAT 314  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| PHY 112  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Religion   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| <p><b>Senior Year (First Semester), 14 Hrs.</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%; text-align: center;">GRADE</th> <th style="width: 30%; text-align: center;">SEMESTER</th> </tr> </thead> <tbody> <tr><td>CHE 431</td><td>_____</td><td>_____</td></tr> <tr><td>CHE 441</td><td>_____</td><td>_____</td></tr> <tr><td>Humanities</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> </tbody> </table> <p>SEM. CR. HRS. _____ SEM. GPA _____</p>   |       | GRADE    | SEMESTER | CHE 431 | _____ | _____ | CHE 441 | _____ | _____ | Humanities | _____ | _____ | Elective | _____ | _____ | Elective   | _____ | _____ | Elective | _____ | _____ | <p><b>Senior Year (Second Semester), 15 Hrs.</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%; text-align: center;">GRADE</th> <th style="width: 30%; text-align: center;">SEMESTER</th> </tr> </thead> <tbody> <tr><td>CHE 432</td><td>_____</td><td>_____</td></tr> <tr><td>CHE 442</td><td>_____</td><td>_____</td></tr> <tr><td>CHE 443</td><td>_____</td><td>_____</td></tr> <tr><td>or</td><td></td><td></td></tr> <tr><td>CHE 480</td><td>_____</td><td>_____</td></tr> <tr><td>Elective</td><td>_____</td><td>_____</td></tr> </tbody> </table> <p>SEM. CR. HRS. _____ SEM. GPA _____<br/>TOTAL CR. HRS. _____ CUM. GPA _____</p> |       | GRADE | SEMESTER   | CHE 432 | _____ | _____    | CHE 442 | _____ | _____   | CHE 443 | _____ | _____    | or      |       |       | CHE 480 | _____ | _____ | Elective | _____ | _____ |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 431  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 441  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Humanities   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
|  | GRADE | SEMESTER |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 432  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 442  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 443  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| or   |       |          |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| CHE 480  | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |
| Elective   | _____ | _____    |          |         |       |       |         |       |       |            |       |       |          |       |       |            |       |       |          |       |       |   |       |       |  |         |       |          |         |       |   |         |       |          |         |       |       |         |       |       |          |       |       |          |       |       |          |       |       |          |       |       |         |       |       |          |       |       |          |       |       |



# **APPENDIX 11**

## **Resume of Drs. Hurley and Turner**

ORIGINAL PAGE  
COLOR PHOTOGRAPH  
PAGE.

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# *JOHN S. HURLEY*

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*HAMPTON UNIVERSITY*  
*DEPARTMENT OF MATHEMATICS (APPLIED)*  
*HOME TELEPHONE: 804 - 595 - 2687 (UNLISTED)*  
*BUSINESS TELEPHONE: 804 - 727 - 5352*

## *CAREER OBJECTIVES:*

To continue to expose and inform students of the virtues of education as it pertains to the fields of mathematics, science, and engineering, and to the vast alternatives that are generated by pursuing opportunities in these fields. To develop and maintain a consistent degree of quality research in the field of electronic materials and microelectronic devices.

## *EXPERIENCE:*

Presently: Associate Director for Carnegie Mellon University - Hampton University (CMU - HU) Center of Excellence in Nonlinear Analysis at Hampton University, Hampton, VA

*August 1990 -*

*Present*

Associate Professor - Department of Mathematics (Applied Emphasis), Hampton University. Study of electronic materials and their implications in developing new and improving existing microelectronic devices. Present interest has focused primarily on III - V and IV - IV compounds (GaAs and SiC systems). Interest extending to smart material devices.





*May 1990 -*

*August 1990*

ASEE Summer Fellow (NASA Langley Research Center, Langley, VA) research emphasis on electronic materials that can be used to develop aerospace sensors. Most of the work was dedicated to pressure measurements (piezoresistive sensors).

*January 1989 -*

*May 1990*

Assistant Professor - Department of Electrical Engineering, University of South Carolina (Columbia) - emphasis on electronic materials and microelectronic devices. Courses taught - Electricity and Magnetism I - Undergraduate course - text: Hayt - Engineering Electromagnetics, Fourth Edition; Materials and Devices - text: Materials and Devices for Electrical Engineers and Physicists - R. Colclaser and S. Diehl-Nagle.

*August 1984 -*

*August 1988*

Instructor - Howard University, Washington, D.C., Department of Electrical Engineering. Course Taught - Electricity and Magnetism I, Undergraduate course- text: Engineering Electromagnetics - Hayt; Network Analysis I, Undergraduate course-text: Introduction to Network Analysis-Hayt and Kimmerly.

*January 1982 -*

*August 1984*

Instructor - University of Pittsburgh, Subjects taught - Chemistry and Physics in undergraduate development program.

*1979 - 1980*

Research Physicist - U.S. Army Aeromedical Research Laboratory, Ft. Rucker, AL. Study of spectral qualities of the Integrated Helmet and Display Sight System (IHADSS).



## *PUBLICATIONS:*

"The Effects of Interface Roughness on the Current - Voltage Characteristics of Double Barrier Resonant Tunneling Structures" (Ph.D. Dissertation, January 1991)

"The Effects of Interface Roughness on the Current - Voltage Characteristics of a Real Tunneling Diode"- International Journal of Superlattices and Microstructures, J.D. Bruno (U.S. Army Harry diamond Laboratories, Adelphi, MD and J.S. Hurley, Hampton University Department of Mathematics (Applied)), Vol. 11, No. 1 (January 1992)

"GaAs and SiC - Aerospace Sensor Material" (Abstract accepted by Instrumentation Society of America Conference, May 1991, San Diego,CA)

"Material Effects of III - V Based Devices" - Abstract accepted by the Virginia Academy of Science, April 1991.

## *INVITED TALKS:*

California State University - Northridge - Hybrid Microelectronic Devices (1990)

University of North Carolina - Charlotte - Transmission Resonance of a Modulated Potential (1990)

Harry Diamond Laboratories - The Effect of Interface Roughness on the Current - Voltage Characteristic of a Resonant Tunneling Double Barrier Structure (1990)

University of Dayton - Modelling of Real Double Barrier Resonant Tunneling (DBRT) Structures (1991).

## *EDUCATION:*

Ph.D. (Electrical Engineering) - Howard University Department of Electrical Engineering: The Effect of Interface Roughness on the Current - Voltage Characteristic of a Real Diode Structure.



# BIOGRAPHICAL SKETCH

JAMES C. TURNER JR.

Office address:  
Hampton University  
Director  
Center for Nonlinear Analysis  
Department of Mathematics  
Hampton, Virginia 23668  
804-727-5352

The Ohio State University  
Department of Mathematics  
100 Mathematics Building  
231 West 18th Avenue  
Columbus, Ohio 43210-1174  
614-929-0692

## EDUCATION

Ph. D. in Applied Mathematics  
Carnegie Mellon University 1986

M.S. in Applied Mathematics  
University of Michigan 1977

B.S. in Mathematics  
University of New Orleans 1973

## PROFESSIONAL EXPERIENCES: MATHEMATICS EDUCATION

Hampton University  
Director, Center for Nonlinear Analysis  
Tenured Associate Professor of Mathematics  
1991-present

Director of Academic Programs  
The University Consortium for Research and Development  
1991-present

This Consortium, composed of 7 Midwestern universities and 19 Historically Black Universities and Colleges (HBCUs), was formed to meet the need for new approaches to inter-university research in areas of high technology, expand knowledge and personnel in critical areas of technology, and enhance HBCUs R&D activity. The educational leaders of the Consortium are looking at the Hampton University-Ohio State University's pilot program as a model to promote these efforts.



## PROFESSIONAL EXPERIENCES: RESEARCH

Center of Excellence of Research in Nonlinear Analysis  
Director  
May 1991 - present

Carnegie Mellon University in conjunction with Hampton University was awarded a \$3 million, five-year contract from the Army Research Office to establish a Mathematical Center of Excellence in Nonlinear Analysis.

The Center of Excellence in Nonlinear Analysis will focus on fields related to material science and engineering such as metallurgy, plastics and geology. It will be among the leading centers in the country conducting such research, which could affect the development of products ranging from semiconductors to braces. This project has the dual goals of improving our country's technological competitiveness and increasing the nation's pool of minority scientists.

Conference of the Center for Nonlinear Analysis  
Computational Methods in Materials Science  
Organizer  
September 16-18, 1992

Conference of the Center for Nonlinear Analysis  
MATHFEST 1991  
Organizer/ Speaker  
November 15-16, 1991

In order to further expose students to the world of research in mathematics and computational science, selected participants were invited to attend a mathematical conference. The specific conference "Mathfest 1991" focused on advanced topics of applied mathematics.

REMSA INCORPORATED  
Consultant: March 1990 - January 1991

This project developed a modular algorithm for stimulating realistic Chemical Vapor Deposition Reactor configuration. In addition, it provided a tool for further understanding of such processes and for designing new or alternate CVD reactor configurations.

LOS ALAMOS NATIONAL LABORATORY  
Consultant: August 1985 - 1990

Consultant on computational techniques for fluid dynamics.

BELL LABORATORIES  
Consultant: August 1985

Consultant on computational techniques for fluid dynamics.





## INVITED LECTURES

*Proposed Program Description For The Joint Science and Technology Alliance*  
Palace Knight  
Wright-Patterson AFB  
Dayton, Ohio, August 1992

*Infinite-Dimensional Dynamical Systems in Mechanics and Physics*  
Arizona State University  
Tempe, Arizona, Spring 1992

*Issues Related to the Graduate Education of African Students,*  
Edward Bouchet Conference  
Atlanta, Georgia, March 1992

*The Fate of the Minority Mathematics Students*  
Panel Discussion  
National Association of Mathematicians / Mathematical Association of America  
Baltimore, Maryland, January 1992

*Programs for Attracting Students to Graduate Schools and  
Research Careers in Mathematics and Computational Science,*  
The National Security Agency Interchange '91 Conference,  
Fort Meade, Maryland, March 1991

*Nonlinear Galerkin Method for the Simulation of Turbulent Flows,*  
Second Edward Bouchet International Conference on Physics and  
Technology, University of Ghana, Accra, Ghana, Summer 1990

*Evaluation of Simple Analytic Expressions,* Elizabeth City State University,  
Elizabeth City, North Carolina, Spring 1990

*A Novel Approach to Turbulence Modeling,*  
Carnegie Mellon University,  
Pittsburgh, Pennsylvania, Fall 1990

*Math Literacy: A Prerequisite For The Future,*  
Engineering and Science Careers for Minorities,  
Sponsored by Greater Dayton Chapter of Blacks in Government  
and The Ohio State University, Dayton Ohio, Fall 1990



## SELECTED PUBLICATIONS

*Temperature Control In Polymer Extrusion Processes*,  
with L. Steven Hou (York University)  
*Proceedings of the First World Conference in Applied Computational  
Fluid Mechanics*, May 24-28 1992

*Issues Related to the Graduate Education of African Students*,  
with Lester Rodney (Morehouse College).  
*Proceedings of the Edward Bouchet Conference*  
Atlanta, Georgia March 1992

*Nonlinear Galerkin method for the Simulation of Turbulent Flows*,  
*Proceeding of the Second Edward Bouchet International Conference*,  
Accra, Ghana, August 1990

*On a Zero Equation Model of Turbulence*,  
*Numerical Methods for Partial Differential Equations*, May 1989

*Finite Elements Approximation of the Zero Equation  
Model of Turbulence*,  
*Journal of Computational Mathematics and Applications*, July 1988

*The Duplication of Frequency of Laser Radiation  
Through Nonlinear Media*,  
submitted to *Journal of Computation Physics*

*Turbulent Modeling and Computation Using Nonlinear  
Galerkin Method*,  
with Max Gunzburger (Virginia Tech), submitted to SIAM Journal on  
Numerical Analysis

## SPONSORED RESEARCH

### Funded Activities

Center for Excellent for Research in Nonlinear Analysis  
Amount : \$652,812  
Principal Investigator : James C. Turner Jr.  
Sponsor: Army Research Office  
Fiscal Years 1991 - 1993

A Program for Strengthening the Infrastructure for research in the  
Department of Mathematics at Hampton University  
Amount : \$354,672  
Principal Investigator : James C. Turner Jr.  
Sponsor: National Science Foundation  
Fiscal Years 1991 - 1993

